ECLIPSES IN HINDU LIFE AND THOUGHT

By

DR. JAYASREE HARIHARAN

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THE KUPPUSWAMI SASTRI RESEARCH INSTITUTE
MADRAS - 600 004

JACL-KRC
015001

1995

राष्ट्रिय संस्कृत संस्थान, जयपुर परिसर

पुस्तकालय

पुस्तक संख्या ....

वर्गीकरण संख्या ....

15001

General Editor : S. S. JANAKI

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पुस्तकालय
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यह पुस्तक नीचे अङ्कित तिथि या उससे पूर्व लौटा दी जानी चाहिये। यदि पुस्तक निर्धारित तिथि से अधिक समय तक पाठक अपने पास रखेंगे तो 50 पैसे प्रतिदिन के हिसाब से विलम्ब शुल्क देय होगा।

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THE KUPPUSWAMI SAS

MADRAS-6

1995

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First Edition 1995
600 copies

Price : Rs. 70/-
$ 8 ; £ 5

JACL-KRC
015001

ISBN : 81-85170-08-8

Cover Photo : The Solar Corona
(The Total Solar Eclipse, Oct. 24, 1995)
Courtesy : Mr. V. S. Venkataraman

Printed at : Anuradha Letter Prints, Madras-4.

FOREWORD

Captain Dr. G. Srinivasamurti, whose birth centenary was worthily celebrated in 1987, was a veteran and pioneer in Indian Medicine (Āyurveda). As the Honorary Director of the Adyar Library during 1934-54, he had made valuable contribution to different branches of Sanskrit studies and Indology. Dr. G. Srinivasamurti Foundation, a public charitable Trust, started in 1982 by his family members, has been appropriately sponsoring under its aegis, projects, publications, etc. related to our traditional sciences and śāstras. Amongst such projects, a study on 'Eclipses in Hindu Life and Thought' was undertaken by Dr. (Mrs.) Jayasree Hariharan in Sept. 1988 under the guidance of Dr. S. S. Janaki, former Director of the Kuppuswami Sastri Research Institute and a Member of the above Foundation. Apart from guiding the project Dr. Janaki had also agreed to bring it out as a publication of the Institute. The Foundation is much indebted to her·

The present monograph in five chapters, has brought together and analysed relevant mythological, semi-scientific and scientific information on eclipses (grahaṇas) scattered in the Vedic literature, Epics, Purāṇas, Jyotiṣa and Dharma Śāstra literature. The documented study has indeed highlighted some crucial points about eclipses, their concepts and explanations in the varied texts. It is revealing that astronomers like Brahmagupta, Bhāskara and Śrīpati, scientifically computed the eclipses; they also tried to bring about a reconciliation by stating that Rāhu through the medium of moon and shadow of earth, causes solar and lunar eclipses respectively.

The monograph deals adequately in the concluding chapter, with the various rituals and expiatory acts to be performed in order to counteract the negative effects of the shadows of sun and moon on terrestrial life. The Appendix contains valuable material from Vedic and Astronomical texts, on the effects on human life of the actual occurrence of the eclipse in its various stages.

I congratulate Dr. Jayasree for preparing this useful monograph. I am sure that it will be of interest to scientists, Śāstrajñas, and common people and also lead to further inter-disciplinary studies on the subject.

Dr. V. NARAYANASWAMI
Chairman,
Doctor G. Srinivasamurti
Foundation

Madras
18th Oct. 1995

PREFACE

I am happy that the project undertaken by Dr. (Mrs.) Jayasree Hariharan on 'Eclipses in Hindu Life and Thought' in 1988 at the Kuppuswami Sastri Research Institute under my guidance with the financial support from Captain Dr. G. Srinivasamurti Foundation, was successfully completed in 1990 and is now published in the Institute's Golden Jubilee year. Thanks are due to the members of the above Foundation for also providing the necessary publication expenses.

The Institute is sincerely thankful to Dr. V. Narayanaswami, the senior most living disciple of Dr. Srinivasamurti, Chairman of Dr. Srinivasamurti Foundation and a life member of the Kuppuswami Sastri Research Institute, for contributing the Foreword.

The assistance for this project of an inter-disciplinary nature was most welcome to the Institute already involved in such academic activities. I may be permitted to mention some of these in this context - like the research work of Dr. A. S. Ramanathan (former Deputy Director-General of Meteorology) on 'Weather Science in Ancient India' during 1983-86 as a Research Fellow of the Indian National Science Academy; the seminars on 'Sanskrit and Science' held in Oct. 1994 (with Dr. Raja Ramanna as President) and 'Sanskrit and Medical Science' in Jan. 95 (with Dr. B. Ramamurthi as President) to mark the Golden Jubilee of the Institute.

The present monograph is a study of the ancient Indian Thought on Eclipses imbedded in some branches of Sanskrit Literature. By its very nature the topic is both technical and literary. It is vast, varied and complicated. Starting from the *Ṛg Veda* in which references to eclipses occur in mythological terms, there are diverse ideas on and explanations of the concept and cause of the eclipses. Besides, the institutional wisdom of ancient sages understood the occurrences of eclipse not just as a physical event but as a planetary phenomenon having an impact on the terrestrial life. They were also able to provide the mathematical calculations regarding the time, duration, conditions and direction of the eclipse.

In order to prepare the ground for large scale studies, to cover all the above perspectives adequately, Dr. Jayasree has collected and analysed some important references to eclipses in the Vedas, Epics, Purāṇas and Jyotiṣa texts. Besides critically studying the texts, she has clarified the technical ideas by personally interviewing some traditional scholars and modern scientists—

Dr. C.P. Gopalaraman, Executive Director, Tamil Nadu Science and Technology Centre, Madras; Mr. S. Gopinath, Asst. Director, Birla Planetarium, Madras; Dr. K. K. Raja, Dr. K. V. Sarma, Prof. K. V. Seshadrinathan and Sri T. K. Chayapathi Sarma. Thanks are due to them for their help.

The Smṛtis and Dharma Śāstras deal elaborately with specific religious duties like prayer, *homa* and *śrāddha* to be performed during the eclipse period and also prohibit eating, studying Vedas etc. As per the wishes of the members of Dr. Srinivasamurti Foundation such rites have been dealt with in a separate chapter. The negative effects of the shadows of astronomical bodies on living beings and the efficacy of rituals still remain matters of inquiry. It is of interest to know that environmental experiments were carried out during the solar eclipses in February 1980 and October 1995 to evaluate the effects, if any, of eclipses on the life on the earth. More such experiments would perhaps bring out the scientific background of the ritualistic prescriptions and prohibitions.

I thank the academic staff of the Institute, Dr. V. Kameswari, Mr. K.S. Balasubramanian and Mr. T.V. Vasudeva for assistance in proof-reading and verifying the Index.

Madras
19th Oct. 95

S. S. JANAKI
Adviser

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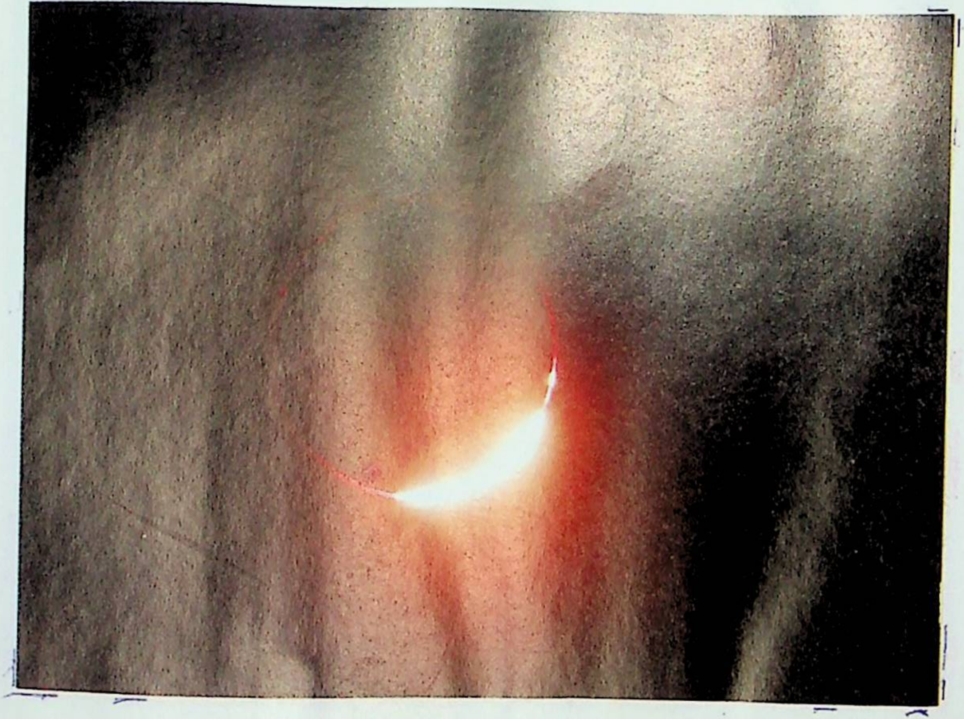
THE CHROMOSPHERE & BAILEY'S BEADS



TOTAL SOLAR ECLIPSE OCT. 24, 1995
KALPI, U.P., INDIA

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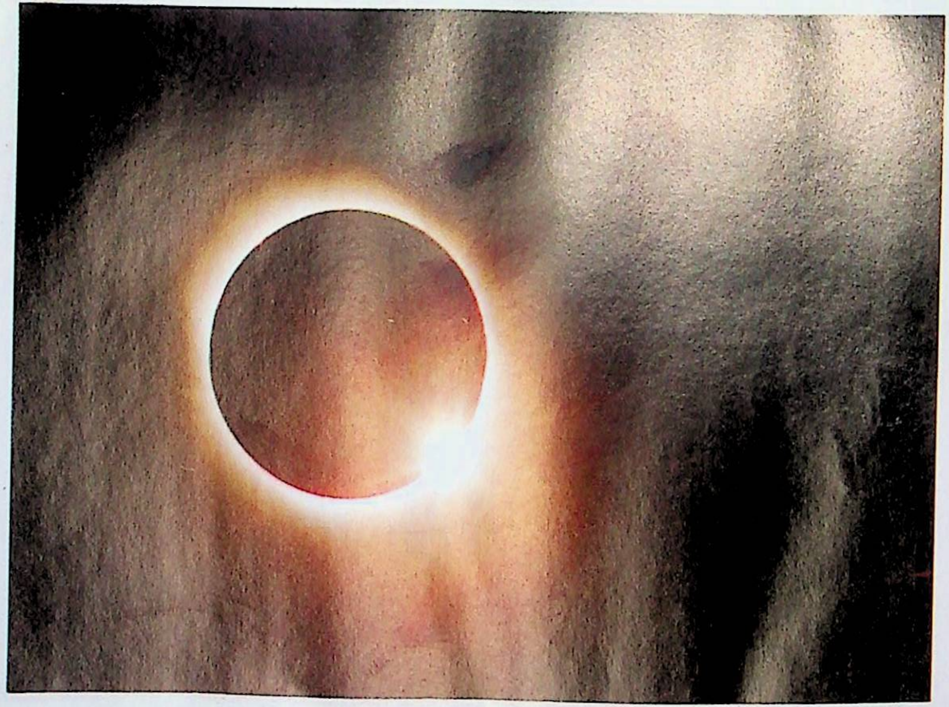

TOTAL SOLAR ECLIPSE OCT. 24, 1995
KALPI, U.P., INDIA
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VEDIC LITERATURE

The earliest references to astronomy in Indian literature are found in the Vedas. The ritualistic aspect of the Vedas depended on astronomy for fixing the time for the performance of various sacrifices. In fact Jyotiṣa is an integral branch of the Vedas and hence is recognised as an accessory of the Veda (Vedāṅga). The Vedas are rich with myths containing plausible explanations of natural phenomena and it would be appropriate to have a glimpse of some references to the phenomena of eclipses.

The most ancient and important source of Vedic mythology is the *Ṛgveda*, in which we find references to eclipse in mythological terms. The term Suvarbhānu/Svarbhānu which later became a synonymn for Rāhu is found in the *Ṛgveda* (5.40.5)[1]. In the *Ṛgveda* however Svarbhānu, is considered a demon and is also said to envelop the sun with darkness. This myth is discussed also in the Brāhmaṇas which speak of 'the darkness' created by the 'demon Svarbhānu' as being the cause of the concealment of the sun. The term Rāhu is found for the first time in the *Atharvaveda* (19.9.10). The *Chāndogya Upaniṣad* (8.13.1) also refers to the idea of Rāhu devouring the moon during the eclipse. Even later Indian astronomers who knew the precise cause for the eclipses and could calculate its exact time, did believe in such popular legends like Rāhu swallowing the sun or moon to cause eclipses.

The earliest reference to the term *'upaplava'* for eclipse seems to occur in the *Kauśika Sūtra* (100.1) belonging to the *Atharvaśākhā*. Here we come across the term *'candra-*

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[1] A similar idea is echoed in the *Samyuttanikāya* 1.2.1.9.10, which describes Rāhu seizing the sun and moon, thereby troubling them and later setting them free.

upaplava' to mean 'lunar eclipse'. The terms *'grāhyāḥ'* (*A.V.* 2.10.8) and '*jagrāha*' (*Gop. Br.*1.2.17) are also used in the ordinary sense of 'catching hold of'.

We may now examine in detail the references to eclipses in the Vedic Saṁhitās and Brāhmaṇas.

Ṛgveda

The earliest Ṛgvedic reference (5.40.5-9)[2] states that when the 'demon Svarbhānu' overpowered the sun with darkness, the entire world looked bewildered like those not knowing where they stood. At that time Indra was dispelling the *māyā* (illusion) caused by Svarbhānu. Atri offered the fourth sacred prayer when the clouded sun was manifested to the sage. Sūrya prays to Atri and Varuṇa for protection so that he may not be swallowed by the oppressor. Thereupon Atri sets the press stones, propitiates the gods with reverence, places the eye of Sūrya in heaven and thus dispels the delusions of Svarbhānu.

In this Ṛgvedic reference, the demon Svarbhānu is stated to have caused the concealment of the sun. He is referred to as an *āsura* (5.40.5,9). It is noteworthy that the pre-Sāyaṇa commentator Veṅkaṭa Mādhava (11th cent. A.D.) explains the term *āsura* as *asuraputra*, the son of a demon and *Saiṁhikeya*, the well known epithet of Rāhu as 'the son of Siṁhikā'[3]. Mudgala and Sāyaṇa (14th cent. A.D) refer to the demon as *prāṇāpahartuḥ putraḥ* i-e., the son of one who takes away life. Sāyaṇa also gives another interpretation of *āsura* as 'the descendant of an *asura*' (*asuryā vā putraḥ*). The demon is referred to as *drugdhaḥ*, 'malicious' in 5.40.7. Veṅkaṭa Mādhava interprets *drugdhaḥ* as *ninditaḥ asuraḥ* (despicable demon). The demon is also attributed with the power of swallowing the heavenly body. This is made clear in the hymn 5.40.7 wherein Sūrya beseeches the protection of Atri and Varuṇa from being devoured by the hungry demon.

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[2] यत्त्वा सूर्य स्वर्भानुस्तमसाविध्यदासुरः ।
अक्षेत्रविद्यथा मुग्धो भुवनान्यदीधयुः ॥ 5 ॥
स्वर्भानोरध यदिन्द्र माया अवो दिवो वर्तमाना अवाहन् ।
गूळ्हं सूर्यं तमसापव्रतेन तुरीयेण ब्रह्मणाविन्ददत्रिः ॥ 6 ॥
मा मामियं तव संतमत्र इरस्य द्रुग्धो भियसा नि गारीत् ।
त्वं मित्रोऽसि सत्यराधास्तौ मेहावतं वरुणश्च राजा ॥ 7 ॥
ग्राव्णो ब्रह्मा युयुजानः सपर्यन् कीरिणा देवान्नमसोपशिक्षन् ।
अत्रिः सूर्यस्य दिवि चक्षुराधात्स्वर्भानोरप माया अघुक्षत् ॥ 8 ॥
यं वै सूर्यं स्वर्भानुस्तमसाविध्यदासुरः ।
अत्रयस्तमन्वविन्दन्न ह्यन्येऽशक्नुवन् ॥

Tamas is spoken of as the obscuring factor of the disc of the sun. Here (5.40.5) it is said that the demon Svarbhānu struck (*avidhyat*) the sun with darkness. Mudgala and Sāyaṇa explain the term *avidhyat* as *āvrṇot* i-e., 'concealed'. The expression *gūḷham sūryam tamasā* (5.40.6) makes it clear that the sun was completely hidden by *tamas*. Regarding what was exactly this *tamas* which obscured the disc of the sun the commentator Veṅkaṭa explains that it is *andhakāra* or blinding darkness. Sāyaṇa and Mudgala take *tamasā* in the sense of *māyānirmitena* i-e., created through *māyā*. *Tamas* is also described here (5.40.6) as *apavrata* or inactive. Perhaps the darkness was so total that it led to inactivity. The commentators Mudgala, Sāyaṇa and Veṅkaṭa take *apavratena* in the sense of *apagatakarmaṇī* meaning 'devoid of activity'[4]. Sāyaṇa explains that since this *tamas* or *andhakāra* was *āvaraṇarūpa* (of concealing nature) it is described as *apavrata*. That *tamas* or darkness gave rise to fear is understood by the use of the term *bhiyasā* (5.40.7), which is explained by Mudgala and Sāyaṇa as : *bhiyasā bhayajanakena tamasā*.

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[3] *Mahābhārata* (1.65.30), *Bhāgavata* (6.6.37), *Vāyu* (67.59-60), *Brahmāṇḍa* (3.5.12-13; 3.6.20.21) etc., speak of 'Svarbhānu/Rāhu' as the 'son of Siṁhikā and Vipracitti'. *Matsya* (6.20-21), *Padma* (5.53-54), *Vāyu* (68.14) and *Viṣṇu* (1.27.5,7) Purāṇas attribute the parentage of Svarbhānu/Rāhu to Kāśyapa and Danu.

That this obscuration of the sun through *tamas* was a result of the illusion of the demon is alluded to in the hymn 5.40.6 which states that when Indra was trying to dispel the *māyā* of Svarbhānu, Atri was able to recover the sun covered with darkness through his fourth sacred prayer. In the hymn 5.40.8 it is stated that Atri after having dispelled the delusions of the demon placed the eye of Sūrya in heaven. Sāyaṇa in this context gives the definition of *māyā* :

स्वाश्रयमव्यामोहयन्ती परांस्तु तथा कुर्वती मायेत्युच्यते ।

Accordingly *māyā* has two functions viz., to hide the truth and to manifest the untruth. It is the veiling capacity of *māyā* that is referred to here. It does not delude its own *āśraya* (abode) but has the power to delude others. *Māyā* is described in the hymn 5.40.6 as spreading itself beneath the sky. Mudgala and Sāyaṇa explain that the *māyā* was such that it enveloped the brilliant sun in the sky from underneath as it is incapable of enveloping from above.

The description that we get here reflects the bewildered and confused state of the beings in the world at the disappearance of the sun all of a sudden[5]. Sāyaṇa and Mudgala say that at that time the people were ignorant of the topography of the place. Veṅkaṭa says that the entire beings in the world started meditating like an *akṣetrajña*.

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[4] *V.S.* 17. 47. तां गूहत तमसापव्रतेन......... ।

Uvaṭa comments as — व्रतमिति कर्मनाम । अपगतकर्मणा । येन तमसार्धंव्याप्तानां नश्यन्ति कर्माणि तदपव्रतं तमः, तेनापव्रतेन तमसा वा गूहत । Mahīdharācārya says: कीदृशेन तमसा ? अपव्रतेन अपगतं व्रतं कर्म यस्मात् तेन । येन व्याप्तानां कर्म नश्यति तादृशेन तमसा ।

Elsewhere (*R.V.* 5.40.6, 8 & 9) sage Atri is credited with the power of dispelling the darkness. Atri is addressed here (5.40.7) as *mitra* (friend) and *satyadhana* (rich in truth) by Sūrya who prays for his protection. It appears that Atri was assisted by Indra in this venture of dispelling the darkness[6].

It was seen above that Atri alone was able to see the sun covered by darkness through his fourth sacred prayer (5.40.6), while Indra dispelled the *māyā*. Veṅkaṭa explains this myth by stating that the first three *aṁśas* (parts) of *tamas* were removed by Indra by his three *laukika upāyas* (material means) while the remaining part of darkness was removed by Atri. A passage from the *Taittirīya Saṁhitā* (2.1.2.2.) is quoted here by Veṅkaṭa and Sāyaṇa for further clarification. Accordingly, Sāyaṇa says that each one of the first three *māyāṁśas* was removed one by one by each of the three Ṛks, and the fourth hiding part of *tamas* was removed by Atri by the fourth *mantra*. Mudgala and Sāyaṇa interpret *turīyeṇa brahmaṇā* as meaning the fourth *mantra* (*caturthena mantreṇa*). '*Grāvṇo brahmā*' (5.40.8) is said to be the hymn under reference.

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[5] S.B. Dixit (*History of Indian Astronomy*, p. 58.) says that the description of the total solar eclipse found in the *Rgveda* does not betray a high degree of amazement or horror and that "in those times eclipses had become quite familiar and the dread of that phenomenon had lost much of its edge".

[6] Regarding the role played by Indra in dispelling the *tamas* (*R.V.* 5.40.5, 9) Whitney (*JAOS*. vol. 13, 1889, p. lxiii) observes: "the introduction of Indra as rescuer suggests the possibility rather of an obscuration of the sun by the clouds, since these it is Indra's special province to deal with".

तुरीयेण ब्रह्मणा ग्राव्णो ब्रह्मा इत्यनेनात्रिरविन्दत् ।
- - - - - - - - - - - पूर्वमन्त्रापेक्षया अस्य तुरीयत्वम् ।

Regarding Sāyaṇa's interpretation, B. G. Tilak (*The Orion*, pp. 160-161) says : "the verse wherein these words occur is itself the sixth and Sāyaṇa has to explain that by fourth is to be understood the fourth if we count from the sixth i-e., the tenth verse. The explanation may be good from the ritualistic point of view but ... quite unsatisfactory otherwise." He then interprets '*turīya*' as meaning an astronomical instrument. He says: "*turīya* is mentioned in modern astronomical works as a name for an instrument called quadrant (*Siddh. Śir* XI. 15) and though we may not suppose the same instrument to have existed in the old Vedic days, yet there seems to be no objection to hold that it may have meant some instrument of observation - - - Sāyaṇa has himself interpreted *brahmā* to mean some 'act or action' and I see no reason why we should not understand the phrase *turīyeṇa brahmaṇā* in the above hymn to mean by the action of *turīya* or in other words by means of *turīya* and thus give to the whole hymn a simple and natural appearance - - -."

Sengupta refutes Tilak's interpretation. *Turīyeṇa brahmaṇā* suggests, according to him, the time of the occurrence of the solar eclipse viz., the fourth part of the summer solstice day. He adds[7] : "some say this means a quadrant or the fourth part of a graduated circle which we cannot take to be correct since the use of a graduated circle or its fourth part in Vedic times was an impossibility. We could admit the validity of the interpretation if the event belonged to Brahmagupta's time (A.D. 628). 'Fourth sacred prayer' could be the correct interpretation. As the fourth prayer of the day most likely belonged to the fourth part of the day, we interpret that the eclipse in question was finished in the fourth part of the day. The word *Brahman* itself may mean the summer solstice day. (vide *Sān. Ār.* I.2.; I.18, *Jai. Br.* II.409-10). In other words, the eclipse in question was over in the fourth part of the summer solstice day itself. (Here *turīyeṇa* - *turīyeṇa kālena brahmadivasena)*". On the basis of this and the references to Atri Sengupta has attempted to arrive at the exact time of the solar eclipse spoken of in the *Ṛgveda* as July 26, 3928 B.C.

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[7] *JRASB*, VII, 1941, pp. 92-93.

Interestingly the Ṛk 5.40. 6b *gūḷham sūryam tamasāpavratena turīyeṇa brahmaṇāvindadatriḥ* which as above is interpreted as the 'fourth sacred prayer' employed by Atri for dispelling the darkness of eclipse has also been made use of by Sāyaṇa while commenting on the *Atharva Veda* 7.1.1. to describe the evolution of the soul through *turyāvasthā*, the fourth ultimate impersonal state of the soul.

> तुरीयेण - तुर्यावस्थापन्नेन कारणशरीराभिमानरहितेन सर्वसाक्षिणा चैतन्येन अमन्वत जानन्ति स्म । गूढं सूर्यं तमसापव्रतेन तुरीयेण ब्रह्मणाविन्दद अत्रिः इति हि निगमः ।

The method by which the darkness was dispelled is explained in the eighth Ṛk (5.40.8).[8] Here, Atri is said to

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[8] "Here Atri is alleged to have found out the instant of the end of the eclipse by counting stones together, a practice that was continued even up to the time of Pṛthūdaka (A.D. 864). Cf : Pṛthūdaka's comm. on *Khaṇḍakhādyaka* of Brahmagupta :

अथ देशं परिज्ञातुमिच्छन्ति किं रेखा पूर्वेणापरेण वा तथाभीष्टदेशे स्फुटब्रह्मगणितेन गणयित्वा देशान्तरकर्मणा विना ततो निर्मलाश्मारगुटिका आरोप्य निरूपयेत् ।

(continued)

have set the press stones. Venkaṭa states that Atri set the press stones for extracting the Soma juice (*somābhiṣavārtham grāvṇaḥ yuñjānaḥ*). According to Sāyaṇa and Mudgala, this pressing was done for the sake of Indra-*indrārtham somamabhisuṇvannityarthaḥ*. Further Atri is said to have propitiated the gods with praise (*kīriṇā*) and offering obeisance (*namasā*). Sāyaṇa and Mudgala take the term (*kīri*) in the sense of *stotra*. The word *namasā* is interpreted by Sāyaṇā as *annenahavirlakṣaṇena namaskāreṇa vā* (5.40.8). It means either by doing *homa* with *anna* or by doing *namaskāra*. Venkaṭa takes the word in the sense of 'food thrown into the sacrificial altar' *(vedyām vikṣiptena annena)*. After performing these, Atri placed the eye of Sūrya in the heavens. The term *cakṣus* (5.40.8) is taken in the sense of *maṇḍala* by Mudgala and Sāyaṇa.

> सूर्यस्य सर्वप्रेरकस्य चक्षुः सर्वस्य व्यापकं मण्डलं दिवि अन्तरिक्षे आ अधात् ।

Atri is said to have brought brilliance to the Sun in the sky. Not merely Atri, but his descendants are also glorified as being the only ones capable of removing the darkness which no one else could (5.40.9). Veṅkaṭa Mādhava quotes a passage from *Jaiminīya Brāhmaṇa* (I.80)[9] as another instance of glorification of Atri.

According to scholars like S.B. Dixit,[10] the Ṛgvedic hymn - *nahyanye'śaknuvan* (5.40.9) seems to throw light on the fact that the Atris were good astronomers. He states that the reference to Atri "shows that the descendants of

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i-e., Pṛthu recommends that the time for the beginning of the eclipse should be found by counting beads". Sengupta, *JRASB* VII, 1941, p. 93.

[9] See below section on Brāhmaṇas

[10] *History of Indian Astronomy*, p. 58.

the Atri family had atleast some knowledge of eclipses, if not, the most accurate knowledge necessary for predicting the exact moment of the beginning and ending of an eclipse just as the ancient chaldeans knew that the eclipses recur with every cycle of 6586 days or 223 lunar months". He concludes that the popular beliefs of those times had a leaning towards the knowledge of the true causes.

Whitney[11] is of the view that these allusions may be understood as echoes of the Ṛgvedic myth than as genuine reminiscences of the eclipse and Atri's exploit in connection with it.

S. R. Das[12] says that the reference to Atri suggests that he was the one who first observed the eclipse and who knew how to calculate the duration and the different phases of the eclipse.

D. K. Kanjilal [13] is of the view that the reference to Atri is presumably a poetic representation of a fact of science. "In the age of Vedas one particular school of sages specialised in observing one constellation of stars or only of the sun or the moon. They were called *nakṣatradarśa*. Atri and his school (including his sons) specialised in observing eclipses. They were aware of the niceties of the phenomenon of eclipses but for dispelling the fear of the people they uttered the sacred Vedic texts. Indra was the deity of the school of Atri. So the incident finds place in the eulogy of Indra composed by Atri".

Taittirīya Saṁhitā

The *Taittirīya Saṁhitā* (2.1.2.2)[14] speaks of the 'demon Svarbhānu' concealing the sun through *tamas*

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[11] *JAOS*, Vol. XIII, 1889, p. lxiii.

[12] *JASB*, Vol. XXIV, 1929, p. 438.

[13] *JOR*, Vols. XLVII—LV, 1989, p. 248.

[14] स्वर्भानुरासुरः सूयं तमसाविध्यत् तस्मै देवाः प्रायश्चित्तिमैच्छन् । तस्य यत् प्रथमं तमोऽपाघ्नन्सा कृष्णाविरभवद्यद् द्वितीयं सा फल्गुनी यत् तृतीयं सा बलक्षी यदध्यस्थादपाकृन्तन्त्साविर्वशा समभवत् ।

(darkness). The gods who desired an atonement were able to dispel the darkness in four successive turns. The first darkness that they struck off became a black sheep, the second a bright coloured one, the third a white one and what they cut from the upper part of the bone is said to have become a barren ewe.

Commenting on this passage, Sāyaṇa says, that with the help of several types of bright *dravyas* (objects) like *maṇi* (gems), the darkness was dispelled in four *paryāyas* (successive turns).

> ----- प्रायश्चित्ति परिहारं विचार्य नानाविधैः प्रकाशरूपै-
> र्मण्यादिद्रव्यैस्तमः अपाघ्नन् चतुर्भिः पर्यायैरपसारितवन्तः ।

The fourth part of *tamas* (darkness) was removed with the help of the *prakāśa* derived from the bones of a dead body and this became a barren ewe.

In this context, Sāyaṇa gives the syllabic etymology of the word Svarbhānu as one who drives away heavenly splendour.

> स्वर्गलोकगतां प्रभां नुदतीति सुवर्भानुः ।

He is dark (*kṛṣṇa-varṇa)* since he has taken upon himself the form of *pṛthvī* (Earth). He is also *tamaḥ-puñja-rūpa* (a collection of darkness). This, Sāyaṇa says, is clear in the *RV*, 5.40.5.

> स च पृथिव्या रूपं धृत्वा कृष्णवर्णः । तमःपुञ्जरूपत्वं "यत्त्वा
> सूर्यः" (5.40.5) इत्येतस्यामृचि स्पष्टमाम्नातम् ।

It is well known that the Earth is dark (*kṛṣṇarūpa*). The *Ch. Up*. 6.4.1 says that *pṛthvī*, the cause of *anna* (food), is *kṛṣṇa-rūpa*. Thus the demon, the embodiment of darkness, concealed the sun through his *tamas*. (Sāyaṇa)

> अतः तमःपुञ्जरूपः स आसुरः स्वकीयेन तमसा सूर्यम् आच्छाद्य
> जगदान्ध्यं कृतवान् ।

Atharva Veda

There is a reference to Rāhu in the *Atharvaveda* 19.9.10.[15] This hymn is an invocation for welfare from the planets associated with the moon, the sun in consonance with Rāhu, smoke-bannered death and Rudra. Here, Sāyaṇa refers to Rāhu as a *graha* and states that the brilliant sun was caught by Rāhu. He also uses the terms *grasta* and *upaplava* in the sense of eclipse[16].

In another context (2.10.8)[17] the same text states that gods like Indra removed the darkness that caught the sun who is of the form of *ṛta* (truth). Here though the text does not refer to Svarbhānu, Sāyaṇa interprets *tamaso grāhyāḥ* as *Svarbhānurūpādgrahāt* i.e., the planet of the form of Svarbhānu.

Brāhmaṇas

In the *Kauṣītakī* (24.3, 4) and the *Sāṅkhāyana Brāhmaṇas* (24.3, 4)[18] there is a reference to the Svarbhānu myth in the context of describing *soma* sacrifice. These references state that when Svarbhānu struck the sun with darkness, the Atris performed the *saptadaśastomas*[19] three days before and after the *viṣuvat*[20] and drove away the darkness. These rites were called *svara-sāmans*[21] since they rescued (*apaspṛṇvata*) the sun from darkness. This reference throws light on the day on which the obscuration of the sun occurred viz., *viṣuvat*. The commentator Udaya explains that through *svara-sāmans*, the great seers called Atri recovered the sun, who was immersed as it were, in the ocean of *māyā* created by Svarbhānu.

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[15] शं नो ग्रहाश्चान्द्रमसाः शमादित्यश्च राहुणा ।
शं नो मृत्युर्धूमकेतुः शं रुद्रास्तिग्मतेजसः ॥

[16] राहुणा ग्रहेण ग्रस्त आदित्यश्च शं शान्त्यै भवतु । आदित्यस्य अतितेजस्वित्वेन इतरग्रहैरुपप्लवाभावात् राहुणेति विशेषितम् ।

[17] सूर्यमृतं तमसो ग्राह्या अधिदेवा मुञ्चन्तो असृजन्निरेणसः । ....

[18] स्वर्भानुर्हासुरादित्यं तमसाविध्यत्तस्यात्रयस्तमोपजिघांसन्त एतं सप्तदशस्तोमं त्र्यहं पुरस्ताद्विषुवत उपायंस्तस्य पुरस्तात्तमोपजघ्नुस्तत्परस्तादसीददेतमेव त्र्यहमुपरिष्टाद्विषुवत उपायंस्तस्य परस्तात्तमोपजघ्नुः...........एतैर्ह वा अत्रय आदित्यं तमसोपस्पृण्वत तद्यदपस्पृण्वत तस्मात् स्वरसामानस्तदेतदृचाभ्युदितम् ।

[19] *Stotra* is a song of praise. *Stoma* denotes a typical form of chanting *stotras* in which the verses are increased by

The account given in the *Śatapatha Brāhmaṇa* (5.3.2.2)[22] states that Soma and Rudra dispelled the darkness caused by Svarbhānu. It is stated here that for the removal of darkness that is black, the offering is in the form of an oblation cooked in milk from a white cow with a white calf. The sacrificial fee for this oblation is a white cow having a white calf.

Commenting on this Vedic reference *Marīci ṭīkā* (p. 296)[23] says that it is not proper to set aside the main

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repetition to a certain number. viz, *trivṛt*, *pañcadaśa*, *saptadaśa*, *ekaviṁśa*, *triṇava*, *trayastriṁśa*, *caturviṁśa*, *catuścatvāriṁśa* and *aṣṭacatvāriṁśa* (*Yajñatattvaprakāśa*, **(p. 91)**.

[20] *Viṣuvat* denotes the middle day of the *gavāmayana sattra*, a sacrificial session of a years duration. (*Ibid*. pp. 128-29).

[21] *Svara-sāman* which forms part of the *gavāmayana sattra* is the name of the six days i.e three days before and three days after the *viṣuvat* on which the *sāmans* called *svara* are chanted. (*loc. cit.*)

[22] स्वर्भानुर्ह वा आसुरः सूर्यं तमसा विव्याध । स तमसा विद्धो न व्यरोचत । तस्य सोमारुद्रावेवैततमोऽपाहता स एषोऽपहतपाप्मा तपति तथो एवैष एतत्तमः प्रविशत्येतं वा तमः प्रविशति यदयज्ञियान्यज्ञेन प्रसजत्ययज्ञियान्वा एतद्यज्ञेन प्रसजति शूद्रांस्त्वद्यांस्त्वत्तस्य सोमारुद्रावेवैतत्तमोऽपहतः सोऽपहतपाप्मैव दीक्षते तद्यच्छ्वेतायै श्वेतवत्सायै पयसि श्रुतो भवति कृष्णं वै तमस्तत्तमोऽपहन्ति तस्यैषैव श्वेता श्वेतवत्सा दक्षिणा ।

[23] यत्तु वेदाचार्येणाप्रतिहतेति यथाश्रुतेऽर्थे कमप्युपक्रमं कल्पयित्वा प्रतारणामात्रेण यथाकथञ्चिदेवोपरागपरत्वं परिहाय श्रुतेरन्यथैव तात्पर्यं तत्सोमारौद्री-

intention of the description of eclipses in the *Śatapatha Brāhmaṇa* and highlight instead the offering of oblation boiled in butter and milk got from a white cow with a white calf.

The *Jaiminīya Brāhmaṇa* (1.80)[24] says that when the sun was covered with darkness by the demon Svarbhānu, the *devas* and *ṛṣis* sought the protection of Atri upon which he dispelled the darkness.

Again in the following passage the *Jaiminīya Brāhmaṇa* (I.81)[25] says that the first part of the darkness that was dispelled became a black sheep, the second one a smoke-coloured sheep and the third one a red sheep.

A similar passage is found in the *Tāṇḍya Brāhmaṇa* (6.6.8)[26] But here Atri is said to have repelled the darkness created by the demoniac Svarbhānu through *bhīsa*. As in the above reference the first part of darkness he removed became a black sheep,[27] but the one he

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चरोरश्वेतायाः श्वेतवश्या(त्सा) पयसा श्रयणपरमार्थवादतया तत्र पद्य(ठ्य)त इत्यनेनोक्तं तदन्याय एव । यतः सम्भवति मुख्येऽर्थे गत्यन्तरप्रकल्पनस्यातिजघन्यत्वात् । अन्यथा लोके घटमानयेत्यादिप्रसिद्धपदेऽपि तदापत्तेः ।

[24] स्वर्भानुर्वा आसुर आदित्यं तमसाविध्यत् । तं देवाश्चर्षयश्चाभिषज्यन् । ते अत्रिमब्रुवन् ऋषे त्वम् इदम् अपजहीति । तथेति तदत्रिरपाहन् ।

[25] स यत् प्रथमम् अपाहन् सा कृष्णाविरभवत् । यद् द्वितीयम् अपाहन् सा धूम्राविरभवत् । यत् तृतीयम् अपाहन् सा फाल्गुन्यविरभवत् ।

[26] स्वर्भानुर्वा आसुर आदित्यं तमसाविध्यत् । तं देवा न व्यजानन् । ते अत्रिमुपधावन् । तस्य अत्रिर्भासेन तमोऽपाहन्यत् । प्रथममपाहन् सा कृष्णाविरभवत् यद्द्वितीयं सा रजता, यत् तृतीयं सा लोहिनी यया वर्णमभ्यतृणत् सा शुक्लासीत् ।

[27] Caland (*Pañcaviṁśa Brāhmaṇa*, Tr., p. 114) refers to the view of Hopkins that the association of sheep in this context could have sprung from the incorrect splitting of the expression *Kṛṣṇavir* as *Kṛṣṇa avir* (black sheep) instead of *Kṛṣṇa āvir* (became dark).

repelled the second time became silvery. The third time it became reddish and that which he set free finally became white.

Dr. K. V. Sarma and B. V. Subbarayappa say that the interesting feature of this passage is the detailed observation of the change of colour in the sun's disc during the progress of an eclipse.[28]

The *Tāṇḍya Brāhmaṇa* 4.5.2, 4.6.13, 14.11.14 and 23.16.2 speak of various modes of prayer like *svara, divākīrtya, bhāsa* and *ekavimśatirātri* by which the darkness was dispelled. In the first of these references the *Brāhmaṇa* (4.5.2)[29] states that when Svarbhānu struck the sun with darkness, the gods delivered it by means of *svara*. According to Sāyaṇa 'āsura' means *asurajātīyaḥ* and *tamas* is the inherent darkness.[30] He adds that through the repetitions of Sāman called *svara*, the gods strengthened the sun for dispelling darkness; hence it is that the *svara-sāmans* chanted even today have the power to protect *āditya*.

The *Taṇḍya Brāhmaṇa* 4.6.13[31] says that *divākīrtya-sāman* was the mode of prayer adopted by the gods to remove darkness. The *divākīrtyas* are the rays of the sun. Sāyaṇa is of the view that it is apt that *divākīrtya* which is of the form of *ādityaraśmi* (rays of the sun) is made use of for dispelling darkness.

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28. *Indian Astronomy A Source Book*, p. 196, fn. 1.

29. स्वर्भानुर्वा आसुर आदित्यं तमसाविध्यत्तं देवा: ।
स्वरैरस्पृण्वन्यत् स्वरसामानो भवन्त्यादित्यस्य स्पृत्यै ।

30. असुरो असुरजातीय: स्वर्भानुर्नाम अन्धकारात्मक: आदित्यं तमसा स्वशरीरभूतेनान्धकारेणाविध्यत्........ ।

31. स्वर्भानुर्वा आसुर आदित्यं तमसाविध्यत्तस्य देवा दिवाकीर्त्यैस्तमोऽपाघ्नन्यद्दिवाकीर्त्यानि भवन्ति तम एवास्मादपघ्नन्ति रश्मयो वा एत आदित्यस्य यद्दिवाकीर्त्यानि रश्मिभिरेव तदादित्यं साक्षादारभन्ते ।

The *Tāṇḍya Brāhmaṇa* 14.11.14[32] speaks of *bhāsa-sāman*. The term *bhāsa* here means 'light'. Sāyaṇa observes that *'bhāsa-sāman'* is significant in as much as Atri used it to restore the lustre and light *(bhāsa)* of the sun.

The *Tāṇḍya Brāhmaṇa* 23.16.2[33] says that by means of the twenty-one day rite, the gods drove away the darkness covering the sun. Sāyaṇa explains the word *etā* here as *ekaviṁśatirātrī*.

The *Gopatha Brāhmaṇa* 2.3.19[34] says that when the sun was struck by Svarbhānu, Atrī dispelled the darkness whence forth *hiraṇya*[35] was given to an Ātreya for removal of *tamas*. The same idea is repeated in the *Gopatha Brāhmaṇa* 1.2.17[36] also. It is to be noted that the reference here is only to *tamas* and not 'Svarbhānu'. 'Jagrāha' is used here in the normal sense of 'seizing'

Upanisads

In the *Chāndogya* (8.13.1)[37] the emancipated self is compared to the moon freeing itself from the mouth of

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[32] स्वर्भानुर्वा आसुर आदित्यं तमसाविध्यत् स न व्यरोचत तस्यात्रिर्भासेन तमोऽपाहन् स व्यरोचत यद्वै तद्भा अभवत्तद्भासस्य भासत्वम् ।

[33] स्वर्भानुर्वा आसुरः सूर्यं तमसाविध्यत्तस्मै देवाः प्रायश्चित्तिमैच्छंस्त एता अविन्दंस्ताभिरस्मात्तमोऽपाघ्नन् ।

[34] स्वर्भानुर्वा आसुरः सूर्यं तमसाविध्यत् । तदत्रिरपनुनोद । तदत्रिरन्वपश्यत् । यदात्रेयाय हिरण्यं ददाति तम एव तेनापहते । अथो ज्योतिरुपरिष्टाद्धारयति स्वर्गस्य लोकस्य समष्ट्यै ।

[35] The practice of honouring an Ātreya in the ritual is confirmed in other texts like *Āp. Ś. S.* XIII, 6.12, *Ś.Br.* IV. 3.4.21, and *Gop. Br.* 1.2.17.

[36] किमुपयज्ञ आत्रेयी भवतीत्यादित्यं हि तमो जग्राह तदत्रिरपनुनोद तदत्रिरन्वपश्यत् ।

[37] चन्द्र इव राहोर्मुखात्प्रमुच्य...etc.

Rāhu. In this context the *Mītākṣara* and *Śaṅkarabhāṣya* use the word 'grasta' in the sense of seizure by Rāhu.[38] A reference to the sun and moon being in the grip of Rāhu is found in the *Tejobindūpaniṣad* (6.94)[39] in the context of the discussion on the non-existence of the phenomenal world. Besides, reference to eclipse as a period for bath and religious acts is found in *Jābāladarśana* (4.55), *Rudrākṣajābāla* (2.18) and *Bhasmajābāla* (2.24) *upaniṣads*.

Astronomers on Vedic references

It is noteworthy that many writers of astronomical texts refer to these Vedic citations in the context of solar eclipse. They even discuss some of these references as instances of eclipse being caused by a demon. As early as A. D. 598 Brahmagupta (*Brahmasphuṭasiddhānta* 21.43)[40] quotes the *Śatapatha Brāhmaṇa* reference as an instance of an eclipse of the sun. He explains that there is unanimity in the statements of *Śruti*, *Saṁhitā* and *Smṛtis* in attributing the cause of eclipses to the demon Svarbhānu/Rāhu. Subsequent authors like Bhaṭṭotpala (A.D. 966), Śrīpati (A. D. 999), Bhāskara II (A. D. 1114), and Viśvarūpa (A. D. 1693) also refer in the same way. Brahmagupta, Bhāskara, Śrīpati and the commentator Viśvarūpa[41] are of the view that since these Vedic references describe eclipse as being caused through *tamas* it is to be understood that the demon Svarbhānu / Rāhu with his inherent darkness enters the shadow of earth and moon and thereby causes eclipses. (For more details on the subject the section on Astronomy below may be seen).

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[38] चन्द्रवद्यथा राहुग्रस्तश्चन्द्रो राहोर्मुखात्प्रमुच्य भास्वरो भवत्येवं...... ।
(*Chāndogya* with *Mitākṣara*).

चन्द्र इव च राहुग्रस्तस्तस्माद्राहोर्मुखात्प्रमुच्य भास्वरो भवति यथैवं... ।
(*Śaṅkarabhāṣya* on *Chāndogya*)

[39] चन्द्रसूर्यादिकौ त्यक्त्वा राहुश्चेत् दृश्यते जगत् ।

[40] स्वर्भानुरासुरिरिनं तमसा विव्याध वेदवाक्यमिदम् ।
श्रुतिसंहितास्मृतीनां भवति यथैक्यं तदुक्तिरतः ॥

[41] स्वर्भानुरिह वा आसुरः सूर्यं(यँ) तमसा विव्याध स विद्धो न व्यरोचतेत्यादिना वेदेन तमोद्वारैव ग्रहणस्य प्रतिपादितत्वेन तस्यातिसुप्रसिद्धत्वात् ।

In this chapter the references from the *Vedas*, *Brāhmaṇas* and *Upaniṣads* were seen critically. The mythopoetic element inherent in the *Vedas* is revealed in full in the Svarbhānu myth. In a retrospect of this section the following highlights of our analysis can be noted—

1. The clear beginnings of the later day concept of Rāhu causing eclipses could be seen in the Vedic Svarbhānu. The Ṛgvedic portrayal of Svarbhānu as a demon who is dreadful (*drugdhaḥ*) and as endowed with the power to swallow (*gārīt*) the sun lends support to this view.

2. In the *Atharva Veda* the word Rāhu itself is made use of. He is even referred to in this Veda as a *graha*.

3. The later day theory of eclipses as the seizure of the heavenly bodies by a demon is to be found in the usages *grāhyāh* (*AV*. 2.10.8) and *jagrāha* (*Gop. Br*. 1.2.17) as referring to *tamas* catching hold of the sun.

4. The mythological designation of eclipse viz. *upaplava*, can be traced to the reference of lunar eclipse as *candra-upaplava* in the *Kauśika Sūtra*.

5. The basis for the rituals performed in connection with eclipses can perhaps be seen in the mode of worship performed by Atri and other gods.

अत्र सूर्यपदं सूर्याचन्द्रमसोस्तमः पदं च भूभेन्द्वोरुपलक्षणपरमिति मन्तव्यम्। तथा च तयोः प्रत्येकं लक्षणयोपस्थितावसुरः स्वर्भानुस्तमसा स्वार्थभूतेनान्धकारेण भूभारूपेण लक्षणीयसूर्यपदोपस्थापितमिदमुभयं याथायोग्यं परस्परपर्युदासाल्लक्ष्यभूतेन चन्द्रेण स्वार्थभूतमादित्यं विव्याधेत्यादिरर्थो यथोचितः सिध्यति।

(*Marīci ṭikā* on *Siddhāntaśiromaṇi*, pp. 295-96)

6. The Vedic references, especially the one found in the *Ṛgveda*, speaks of the great interest that the ancient Indians had for observing various aspects of nature and a capacity to describe them in a mytho-poetic language. The term 'tamas'[42] used in this context is quite significant.

7. So also is the usage of the term *gūḷham* and the portrayal of the bewilderment that the darkness caused.

8. The *Vedas* and the *Brāhmaṇas* speak of Svarbhānu and *tamas* as distinct entities. But, Sāyaṇa explains that *tamas* is inherent in the demon. In one context (*Taittirīya Saṁhitā* 2.1.2.2), he says that the demon is dark by taking upon himself the form of earth and also gives the etymology of Svarbhānu as one who drives away heavenly splendour.

9. *Tamas* in the *Ṛgveda* is portrayed as enveloping the sun from below.

10. This envelopment in the form of *tamas* is described as *māyā* (illusion) perhaps hinting at the fact that the sun is only hidden from our view at a solar eclipse and that no concealment of the sun takes place.

11. The *Brāhmaṇa* references mention the solar eclipse to have occurred at the time of *viṣuvat*.

12. Some of the descriptions found in the *Taittirīya Saṁhitā* and the *Brāhmaṇas* throw light on the gradual change of colour that occurs on the eclipsed disc in the course of an eclipse.

13. In many instances sage Atri is credited with the power to dispel darkness. Perhaps the priests of Atri family had specialised in observing eclipses and also in composing hymns to dispel the evil effect of eclipses.

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[42] Vide the section on Astronomy on the connotation of the term 'tamas'.

EPICS

Myth of Rāhu

The *Rāmāyaṇa* and the *Mahābhārata* contain several references to Rāhu/Svarbhānu swallowing the sun/moon to cause solar/lunar eclipses. E. g. -

राहुमुक्त इवोडुराट् । *Rāmāyaṇa* V. 35. 85 d
राहोर्मुखाच्चन्द्र इव प्रमुक्तः । *loc. cit.* V. 29.7d
मुच्यते सर्वपापेभ्यो राहुणा चन्द्रमा यथा ।
Mahābhārata I. 62. 20a.

Besides, the episode of *amṛtamathana* and the enmity of Rāhu towards the sun and moon are described in the *Mahābhārata* I. 17.2-9. Rāhu in the guise of a god drank ambrosia, the sun and moon detect his presence and inform it to the celestials. Lord Viṣṇu then cuts off the head of the demon with the *cakrāyudha*. It is stated here that since the *amṛta* had gone upto his throat the severed head of the demon Rāhu remains immortal and wreaks vengeance by swallowing the sun / moon and causing eclipses.[1] Again, there is a reference to this episode in the *Mahābhārata* I. 24. 4-9.

The *Mahābhārata* V. 110.11 likens the headless trunk of Svarbhānu intent on swallowing the sun and moon to the sun himself.[2]

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[1] तच्छैलश्रृंगप्रतिमं दानवस्य शिरो महत् ।
चक्रेणोत्कृत्तमपतच्चालयन्वसुधातलम् ॥
ततो वैरविनिर्बन्धः कृतो राहुमुखेन वै ।
शाश्वतश्चन्द्रसूर्याभ्यां ग्रसत्यद्यापि चैव तौ ॥

[2] अत्र मध्ये समुद्रस्य कबन्धः प्रतिदृश्यते ।
स्वर्भानोः सूर्यकल्पस्य सोमसूर्यौ जिघांसतः ॥

Eclipse on non-parva days

There are numerous instances in the *Rāmāyaṇa* and *Mahābhārata* containing descriptions of a solar/lunar eclipse occurring on a non-lunation day. The *Rāmayaṇa* III. 23.12 refers to the demon Svarbhānu seizing the sun on a non-*parva* day.

जग्राह सूर्यं स्वर्भानुरपर्वणि महाग्रहः ।

There are similar descriptions in the *Mahābhārata* II. App. I. 28.98 and IX. 56.10.[3]

The *Mahābhārata* VI. 3. 28[4] says that the sun and moon were eclipsed on one and the same day i.e. the 13th day of the fortnight. This occurrence of eclipse on a non-*parva* day is said to forebode evil. Again the *Mahābhārata* VI. 3. 32-33[5] says that there are instances of a new moon falling on the 14th, 15th or 16th day of the lunar fortnight. But on the 13th day and in the course of the same month both the lunar and solar eclipses had taken place. Hence the sun and the moon undergoing eclipses on unusual days will bring in destruction to all the beings on the earth. Commenting on the above, Nīlakaṇṭha observes that generally a new moon day falls on the 15th day of the lunar fortnight. In case of increase *(vṛddhi)* or diminution *(kṣaya)* of one *tithi* it falls on the 16th or 14th day. But the diminution of two *tithis*, the falling of the new moon on the 13th day of the lunar fortnight and the occurrence of the lunar and solar eclipses in the same month is quite *aprasiddha* and calamitous.[6]

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[3] राहुश्चाप्यपतत्सोममपर्वणि विशां पते ।
राहुश्चाग्रसदादित्यमपर्वणि विशां पते ।

[4] चन्द्रादित्यावुभौ ग्रस्तावेकाह्ना हि त्रयोदशीम् ।
अपर्वणि ग्रहं यातौ प्रजासंक्षयमिच्छतः ॥

[5] चतुर्दशीं पञ्चदशीं भूतपूर्वां च षोडशीम् ।
इमां तु नाभिजानेऽहममावास्यां त्रयोदशीम् ॥
चन्द्रसूर्यावुभौ ग्रस्तावेकमासीं त्रयोदशीम् ।
अपर्वणि ग्रहेणैतौ प्रजाः संक्षपयिष्यतः ।

S. B. Dikshit[7] states that the above lines which speak of a lunar fortnight consisting of thirteen civil days is a rarity and could be a reference to *kṣayapakṣa* or 'missing half'. He is of the view that these could be exaggerations since, even by adopting modern calculations it is impossible to get a thirteen day half month which has a lunar eclipse in the beginning and a solar eclipse at the end. But he says that the above reference throws light on the fact that the people of those times were aware of the phenomenon of the occurrence of a thirteen day half month and they had acquired the knowledge of calculating the true positions of planets though their calculation were less accurate than what are done in the present times.

Kanjilal[8] opines that the eccentricities of rotation and inclination with the ecliptic (resulting in the reduction of its sidereal and synodic periods) are the possible causes of diminution of two days in each month.

The word *ekāhna* in the verse *candrādityāvubhau* (VI.3.28) has been interpreted by K. L. Daftari[9] as 'on the same week day' and *trayodaśīm* as the 13th *tithi* calculated by the wrong method then in vogue. He explains that the real *tithi* was always in advance i.e., it preceded the calculated *tithi* on account of the excessive length of the lunar month then taken for calculation with the result that the interval between the calculated and the actual *tithi* would increase as the cycles advance and could have got accumulated to the extent of about two *tithis* at the time of the war.

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[6] अपर्वणि पर्व दर्शाख्यं पञ्चदशेऽह्नि भवति एकतिथिवृद्धौ षोडशे वा एकतिथिक्षये चतुर्दशे वाह्नि भवति। तिथिद्वयक्षयस्तु लोकेऽत्यन्तमप्रसिद्ध इत्यपर्वणीत्युक्तम्।

[7] *Bhāratiya Jyotish Sastra*, Eng. Tr. pp. 114-16.

[8] *JOR*. Vols. XLVII-LV, 1989, p. 251.

[9] *The astronomical method and its application to the chronology of ancient India*, pp. 6, 19-20.

The *Mahābhārata* XIV. 77.15[10] states that Rāhu caught hold of the sun and moon simultaneously. In XVI. 2.18b, 19[11] it says that on seeing the *amāvāsya* on the thirteenth *tithi*, Kṛṣṇa observed that Rāhu has again made this fourteenth *tithi* as the 15th foreboding destruction. The commentator Nīlakaṇṭha observes that the reference here speaks of a *Kṛṣṇa-pakṣa* consisting of thirteen days and also *kṣaya* or diminution of a *tithi*.[12]

Varāhamihira (*Bṛhatsaṁhitā* III. 6, V. 26) speaks of the evil effects of a solar eclipse occurring on a non-*parva* day as also a solar and lunar eclipse occurring in one and the same month. In this context (V. 26), the commentator Bhaṭṭotpala quotes as an instance the *Mahābhārata*-verse *candra-sūryāvubhau* (VI. 3. 28) and *rāhuragrasat* (XIV. 77. 15). He refers to such phenomenon as rare and unusual and occurring only in an *adhikamāsa*.[13]

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[10] राहुरग्रसदादित्यं युगपत्सोममेव च ॥

[11] त्रयोदश्याममावास्यां तान् दृष्ट्वा प्राब्रवीदिदम् ॥
चतुर्दशी पञ्चदशी कृतेयं राहुणा पुनः ।

[12] त्रयोदशदिवसः कृष्णपक्षोऽभूदित्यर्थः । एवं सत्यग्रिमपक्षे वृद्धया भाव्यं तत्र जातं प्रत्युत एका तिथिः क्षीणा तत्र ग्रहणं च जातमित्याह चतुर्दशीति ।

[13] एवमत्राधिकमासके यदुक्तं तदेव शोभनमृषिवचनादेकमासे त्रयोदश इति ।

Other references to eclipses

A total lunar eclipse that took place on the night when the army of Rāma crossed the bridge built by the monkeys is described in the *Rāmāyaṇa* (VI. 23. 8, 9). Here, the moon is portrayed as devoid of lustre and having its edges blackish red in colour.

In the *Rāmāyaṇa* (VII. 35. 31-60), while describing the exploits of Hanumān, the story of Rāhu being unable to catch hold of the sun during eclipse as Hanumān had already caught him and how Rāhu seeks the help of Indra, is related.

The idea of Svarbhānu enveloping or concealing the sun to cause eclipse is found in the *Mahābhārata* III. 11.52; V. 182.22; VII. 156.80, 175.49.

In the *Mahābhārata* V. 143. 11a there is a description of a solar eclipse about to take place. It is stated there that Rāhu approached the sun which had covered the path of the moon.

सोमस्य लक्ष्म व्यावृत्तं राहुरर्कमुपैति च ।

According to the commentator Nīlakaṇṭha, the expression *lakṣma vyāvṛttam* is an indication of *kṣīṇacandra* (waning moon) being in the proximity of *amāvāsya*.[14] And a solar eclipse taking place on such an *amāvāsya* (i.e. when the moon is in conjunction with the sun) brings disaster to the kings of *soma* and *sūryavaṁśas*. K. L. Daftari[15] interprets the verse to mean that the eclipse of the moon had already happened and Rāhu is approaching the sun i.e. an eclipse of the sun was expected on the next *amāvāsya*. He observes that a solar eclipse sometimes happens on the

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14. लक्ष्म व्यावृत्तं क्षीणत्वादमावास्यासान्निध्यात् क्षीणचन्द्रोऽपि पाप एव ।

15. *loc. cit.* p.32.

amāvāsya before or after a lunar eclipse and this simple law must have been known to the ancient Indians.

A lunar eclipse that took place on the Kārtika full moon is described in the *Mahābhārata* VI. 2. 23.[16] The moon became imperceptible, devoid of lustre and of the colour of fire while the sky was of the colour of lotus i.e. ruddy. Nīlakaṇṭha states that the reddish glow in the sky portends evil. K. L. Daftari[17] observes that this is the description of the moon just before it is eclipsed and the change in the colour of the disc being caused by the penumbra in which the moon enters.

In the Jayadrathavadha-episode in the *Mahābhārata* (VII. 146. 60-70) it is stated that Kṛṣṇa concealed the sun with his disc *sudarśana* in order to bring out Jayadratha from concealment so that Arjuna might kill him. According to Kanjilal[18] there is a reference to a total solar eclipse in this episode. He opines that Kṛṣṇa knew before hand that there would be a solar eclipse in the afternoon. Hence the covering of the disc of the sun could have been a myth. Further the time of covering of the disc of sun and Arjuna's coming before the pyre might take three to four minutes. And this would coincide with the period of totality at a solar eclipse.

Size of Sun, Moon and Rāhu

The *Mahābhārata* VI. 12.39-47 states that Rāhu being bulkier than the sun and the moon, conceals them in due time during eclipses. Herein we get the description of the expanse of the *grahas* sun, moon and Rāhu according to the calculations of Arka as stated there. The planet Svarbhānu which is a globe, has a diameter of twelve thousand *yojanas* and circumference of forty two thousand *yojanas*. The diameter of the moon is eleven thousand *yojanas* while its circumference is thirty eight thousand nine hundred *yojanas*. The sun has a diameter of ten thousand *yojanas* and a circumference of thirty five thousand eight hundred miles.

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[16] अलक्ष्यः प्रभया हीनः पौर्णमासीं च कार्तिकीम् ।
चन्द्रोऽभूदग्निवर्णश्च पद्मवर्ण नभस्तले ॥

[17] *op. cit.* p. 32.

[18] *JOR.* Vols. XLVII-LV, 1989, p. 249.

Reference to Atri

Mahābhārata (XIII. 156. 2-13) speaks of the achievements of Atri. Once during the fight between the gods and the demons, when Rāhu pierced the sun and moon with his arrows, Atri shone like the sun and moon and gave light to the world enveloped by darkness. The reference to Atri here, appears to have its basis in the Ṛg-vedic passage wherein Atri is credited with the power to dispel darkness.

The *Harivaṁśa* 1.31.13,14[19] describes the exploits of Atri when the sun struck by Svarbhānu was about to fall down.

Thus from a perusal of these few references we may note below the highlights of the information on eclipses as gleaned from the epics —

1) The phenomenon of conjunction and opposition ie., new and full moon, was known to them.

2) They also knew that solar and lunar eclipses occur on new and full moon days and that eclipses do not take place on a non-*parva* day.

3) They had observed and noted down the colour of the eclipsed disc especially at a lunar eclipse.

4) The reference to Atri appears to throw light on the fact that there were men capable of predicting the precise beginning and end of eclipse.

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[19] The same passage is found in the *Vāyu* (2.9.71-72) and *Brahmāṇḍa* (2.3.8.77b-79a) Purāṇas.

PURĀṆAS

Myth of Rāhu

The Purāṇas contain some references to eclipses many of which are in the context of the *amṛtamathana* (churning of the ocean). As in the *Mahābhārata*, the *Skanda* (1. 12. 62-66), *Matsya* (251. 12-16), *Bhāgavata* (5. 24. 1-3; 8. 9. 24-26), *Padma* (3. 10. 19-21) and *Śiva* (2.5.15. 6,7,16) Purāṇaṣ give an account of the cutting of Rāhu's head by Lord Viṣṇu at the instigation of Sūrya and Candra at the time of Rāhu drinking *amṛta*. Consequently, Rāhu becomes an arch enemy of Sūrya and Candra and in revenge afflicts them as eclipses. Amongst the Purāṇas the *Skanda* speaks of Rāhu and Ketu mixing themselves with the gods to drink nectar.

Who is Ketu?

Bhāgavata (8.9. 25b-26a) states that while the head of the demon was made to attain the status of a planet (*graha*) by Brahmā, the headless trunk (*kabandha*), not being touched by nectar (*amṛta*), falls down.[1] The commentators Vamśīdhara[2] and Jīvagosvāmin[3] have questioned the propriety of the term 'Kabandha' here. According to them Ketu is a *chāyāgraha* (shadow planet) and not *kabandharūpa* as generally held.

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[1] हरिस्तस्य कबन्धस्तु सुधयाप्लावितोऽपतत् ।
शिरस्त्वमरतां नीतमजो ग्रहमचीक्लृपत् ।।

[2] केतुस्तु छायारूपो ग्रहो न तु कबन्धरूपः, "राहुच्छाया स्मृतः केतुः" इति भुवनदीपिकोक्तेः ।

[3] केतुस्तु छायाग्रह एव न तु कबन्धरूप इत्यभिप्रायः ।

Again Ketu is referred to in the plural in the *Bhāgavata* (5.23.7).[4] According to *Bhāgavata* 6.6.37 [5] Rāhu is the eldest of the one hundred and one sons of Siṁhikā and Vipracitti, the remaining hundred were Ketus. They all attained the status of *grahas*. Vaṁśīdhara (on *Bhāgavata* 5.23.7; 6.6.37)[6] states that the idea of hundred or thousand Ketus is to be found in astronomical texts.

On the other hand, the commentator Vīrarāghava (5. 23. 7[7]) is of the view that Ketu is used in the plural to refer to the asterisms in the shape of Ketu.

According to Varāhamihira Ketu is a comet. In his *Bṛhatsaṁhitā* (11.5)[8] he says that sages like Parāśara speak of one hundred and one Ketus while others such as Garga speak of thousand Ketus. But sage Nārada declares that there is only one Ketu which appears in many forms and places. It is noteworthy that among these thousand Ketus described by Varāhamihira (*Bṛhatsaṁhitā,* 3.7-17; 11. 22), there are thirty three of them named *tāmasakīlakas* that are the offsprings of Rāhu/Svarbhānu.

The *Skanda Purāṇa* (1. 12. 70) says that Ketu is of the form of smoke. According to this account, the discus of Viṣṇu that cut off the head of Rāhu went up the sky and the trunk fell down on the earth creating havoc. Ketu being of the form of smoke disappeared in the sky after handing over the nectar to the moon.[9] The *Padma* (3. 10. 19-21) has a slight variation and speaks of Lord Jagannātha striking Rāhu with the golden vessel while drinking nectar. The head falls separate from the body and begins to be called Ketu and Rāhu.[10]

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[4] ....राहुर्गले केतवः सर्वाङ्गेषु ।

[5] विप्रचित्तिः सिंहिकायां शतं चैकमजीजनत् ।
राहुज्येष्ठं केतुशतं ग्रहत्वं य उपागतः ॥

[6a] बहुत्वं केतूनां सहस्रत्वं शतत्वं च ज्योतिश्शास्त्रे वर्णितमिति तदपेक्षम् ।

b. "केतूनां शतत्वं ज्योतिश्शास्त्रे वर्णितम् । .... एवं संख्या च केतूनां शतं पञ्चोत्तरं भवेत् ।" इति ज्योतिर्निबन्धे ।

[7] केतव इति बहुवचनं केत्वाकारनक्षत्राणां तारासङ्घावाभिप्रायेण प्रयुक्तम् .... ।

[8] शतमेकाधिकमेके सहस्रमपरे वदन्ति केतूनाम् ।
बहुरूपमेकमेव प्राह मुनिर्नारदः केतुम् ॥

Interpretation of Uparāga (eclipse) according to Bhāgavata

Bhāgavata (5. 24, 2-3) gives a new interpretation of the term *uparāga*. Accordingly *uparāga* is nothing but an intervention in the form of confrontation of the sun/moon by Rāhu for a while when Viṣṇu whirls the discus before him. When Rāhu rushes forward to the sun/moon to wreak vengeance, Lord Viṣṇu whirls the discus at him. Frightened by the irresistible discus whirling before him, Rāhu stands looking at it for a while and then retreats trembling with fear. This is called *uparāga*.[11] Śrīdhara in his *Bhāvārthadīpikā* makes this clear—

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[9] केतुश्च धूमरूपोऽसावाकाशे विलयं गतः ।
सुधां समर्प्य चन्द्राय तिरोधानगतोऽभवत् ।।

[10] ततः क्रुद्धो जगन्नाथो जघान स्वर्णपात्रतः ।
शिरस्तस्य पपातोर्व्यां केतुर्नाम्ना बभूव ह ।।
राहुकेतू ततस्तूर्णं गतौ तौ भयविह्वलौ ।
इदानीं तद्दिने प्राप्ते चन्द्रसूर्यौ स युध्यति ।।
कुर्याद्ग्रासं सैंहिकेयस्तत्क्षणं दुर्लभं भवेत् ।।

[11] यः पर्वणि तद्व्यवधानकृद्वैरानुबन्धः सूर्याचन्द्रमसावभिधावति । तन्निशम्योभयत्रापि भगवता रक्षणाय प्रयुक्तं सुदर्शनं नाम भागवत दयितमस्त्रं तत्तेजसा दुर्विषहं मुहुः परिवर्तमानमभ्यवस्थितो मुहूर्तमुद्विजमानश्चकितहृदय आरादेव निवर्तते तदुपरागमिति वदन्ति लोकाः ।

> भागवतं चक्रं परिवर्तमानं परिभ्रमद् अभिमुखं मुहूर्तमवस्थितः
> सन् इत्येवमन्तरा तदवस्थानमुपरागं ग्रहणं वदन्ति ।

According to Vaṁśīdhara and Viśvanātha Cakravarti *uparāga* is a mere intervention (*vyavadhāna*) and thereby concealment which is indicated by the words *madhyapraveśa* i.e., his thrusting himself in between the sun and the moon to drink nectar. Further the *vyavadhāna* is of the form of veiling the eyes of the people of the earth (from direct view of the sun/moon).[12] Vīrarāghava in his *vyākhyā* says that enveloping the disc of the sun/moon by his own *maṇḍala* while rushing forth to attack them is called *grahaṇa*.[13] Hence during eclipses there is no actual *grāsa* (swallowing).

Semi-scientific ideas

Viṣṇucitti, commenting on the *Viṣṇu Purāṇa* (2.12. 21-23) says that the third exalted place above the sun and the moon is that of Rāhu. At the time of eclipses he goes down, takes upon himself the dark circular shadow of earth and obscures the sun/moon like a cloud.[14]

The *Liṅga* (1.57.12), *Vāyu* (1.53. 63b-64), *Matsya* (128. 60, 61) and *Brahmāṇḍa* (1.2.24. 101b-102a) state that the abode of Rāhu is full of darkness and evolved out of the circular shadow of the earth.[15]

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[12] Vaṁśīdhara's *Bhāvārthadīpikāprakāśa* and Viśvanātha Cakravartin's *Sārārthadarśinī*—

पर्वणि अमावास्यापौर्णमास्योः । तयो भूतलस्थजनचक्षुषां व्यवधानं कर्तुममृतपाने तयोर्मध्यप्रवेशेन व्यवधानं पूर्वं कृतवानिति ।

[13] अभिधावनदशायां यत् स्वमण्डलेन सूर्याचन्द्रमसोर्मण्डलाच्छादनं तदेव ग्रहणमिति जना उपरागस्वरूपाभिज्ञा वदन्तीत्यर्थः । तत्र ऋजुवक्रस्थितिभ्यामर्धग्राससर्वग्रासौ न तु वस्तुतो ग्रासोऽस्ति...... ।

[14] अर्केन्द्वोरुपरि तृतीयद्युस्थाने चरन्नपि राहुश्चन्द्रस्यार्कस्य वा ग्रहणकाले अधोगत्वा भूच्छायात्मकं तमोमयं बिम्बं गृहीत्वा तेन तौ (राहुः) मेघवच्छादयन् तत्काल एव दृश्यत्वमेति ।

Sāmba Upapurāṇa (Ch. 22.12. 13,16,19, 29-35) says that during solar and lunar eclipses the sun and the moon are not swallowed by the demon Rāhu, but only concealed like a cloud. On the new moon day Rāhu (as ordained by the creator) approaches the sun in order to have his share of nectar, *amṛtādbhāgaḥ,* from the moon who is in conjunction with the sun on that particular day. In that process he covers the sun as well as the moon. This is how solar eclipses are caused. Likewise on the full moon day Rāhu approaches the moon with the purpose of drinking nectar and covers it by taking upon himself the shadow of earth and thereby causes lunar eclipse. Thus during eclipse the brilliance of the luminary is not diminished but only covered/concealed for some time. Rāhu is said to approach the moon in the bright fortnight and the sun in the dark fortnight. It has also been stated that eclipses occur only during *parvas.*[16]

In the *Devī Upapurāṇa* (ch. 49) reference is made to lunar and solar eclipses being caused by Rāhu in the form of shadow of the earth and the moon respectively.[17]

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15. उद्धृत्य पृथिवीच्छायां निर्मितां मण्डलाकृतिम् ।
स्वर्भानोस्तु बृहत्स्थानं तृतीयं यत्तमोमयम् ॥

16. अतश्छादयते राहुरभ्रवच्छशिभास्करौ ।
राहुरभ्रकसंस्थानं सोममाच्छाद्य तिष्ठति ॥
उद्धृत्य पार्थिवीं छायां धूमान्मेध इवोत्थितः ।
चन्द्रस्य यदवस्पृष्टं राहुणा भास्करस्य च ॥
तेभ्यावखंडितं तस्य केवलं श्यामलीकृतम् ।
कर्दमेन यथा वस्त्रं शुक्लत्वमपहन्यते ॥

17. *Studies in Upapūraṇa*, II. p.51.

Other descriptions of Rāhu

The *Brahmāṇḍa* (1.2.23. 88-91), *Matsya* (127. 9-11), *Vāyu* (1.52. 80-82), *Viṣṇu* (2.12. 21-23) and *Liṅga* (1.57.4) Puraṇas say that eight black or smoke coloured horses draw the dusky chariot of Rāhu. These horses are attached to it forever once they are harnessed. Ketu's chariot is drawn by eight horses of dusky and lac red colour. During *parvas* Rāhu moves from the sun towards the moon and again goes back to the sun from the moon in the solar *parvan*.

The *Brahmāṇḍa* (1.2.24.103b), *Vāyu* (1.53.65b), *Liṅga* (1.61.32) and *Matsya* (128. 63b) speak of the etymology of Svarbhānu as one who pushes or afflicts the heaven by means of his splendour.

In chapter 1.13. 29-31 the *Skanda Purāṇa*, describes the fight between the moon and Rāhu and how Rāhu drank the nectar oozing out from the moon.

The *Liṅga* (1.61.48) and *Brahmāṇḍa* (1. 2. 24. 136b, 137a) say that Rāhu, full of tāmasic vigour, is by nature a dark circular orb, the oppressor of sun and moon and born in the constellation *bharaṇi*.[18] He also causes great distress to living beings.[19]

Influence of Ṛgvedic Svarbhānu

The *Vāyu* (2.9.71-72) and *Brahmāṇḍa* (1.3.8. 77b. 79a) give an altogether different episode of Svarbhānu. Sūrya, struck by Svarbhānu was about to fall down from heaven but due to the blessings of the Brahmarṣi (Atri) did not fall down and thus gave light to the world filled with darkness.[20]

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[18] तमोवीर्यमयो राहुः प्रकृत्या कृष्णमण्डलः ।
भरणीषु समुत्पन्नो ग्रहश्चन्द्रार्कमर्दनः ॥

[19] *Brahmāṇḍa* 1.2.24.97a; *Liṅga* 1.61.25b; *Vāyu* 1.53.88a; *Matsya* 128.55.

स्वर्भानोस्तामसं स्थानं भूतसंतापनालयम् ।

This account seems to have leanings towards the Ṛgvedic passage (5.40.5,9) wherein it is stated that Atri restored the sun from the darkness that engulfed it. (See p. 5 above).

Size of Sun, Moon and Rāhu

There are some interesting details about the relative sizes of the sun, moon and Rāhu. The *Vāyu* (1.53.62-64), *Brahmāṇḍa* (1.2.24. 99b-101), *Liṅga* (1.57.10-12) and *Matsya* (128. 57-60) say that the diameter of the sun is nine thousand *yojanas*. The expanse of its *maṇḍala* is thrice that of its diameter. The extant of the moon is twice that of the sun. Rāhu assumes a size equal to them and moves beneath them. The *Bhāgavata* (5.24.2) says that Svarbhānu is situated 10,000 yojanas below the sun and moves like a constellation. The expanse of the sun is described as 10,000, the moon 12,000 and that of Rāhu 13,000 yojanas.

Marīci ṭīkā on Eclipses

Viśvarūpa in his commentary on *Siddhāntaśiromaṇi* (p. 296) says that the words like *grāsa* (swallowing) should not be understood in the literal sense since no swallowing takes place during eclipses. But the act of earth's shadow eclipsing the moon and the moon eclipsing the sun is allegorically referred to as swallowing.

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[20] स्वर्भानुना हते सूर्ये पतमाने दिवो महीम् ।
तमोऽभिभूते लोकेऽस्मिन् प्रभा येन प्रवर्तिता ।।
स्वस्ति तेऽस्त्विति चोक्तः स[वै] पतन्निह दिवाकरः ।
ब्रह्मर्षेर्वचनात्तस्य न पपात दिवो महीम् ।।

ग्रासादिशब्दाः स्वपरनये पिधेयस्य गिलनोद्गिलनन्यायेनाकर्षणसाम्येनासुरतृप्तिहेतुत्वादिभिश्च सादृश्योपचारात्सर्वेऽपि गौणा एव ।

He further says that in the Purāṇas though the direct reference is only to Rāhu being the cause of eclipse, it goes without saying that he causes eclipses through the medium of *bhūbhā* (earth's shadow) and moon.

Views of Scholars on Eclipses

Alberuni[21] observes that the paurāṇikas did not have the correct knowledge of eclipses as they had placed the moon above the sun and had to necessarily invent some other being to devour the sun and the moon to cause eclipses.

V. Thiruvenkatacarya[22] says that the story is nothing but an allegorical representation of an astronomical fact and its discovery. The sun is Viṣṇu of the Vedas and Viṣṇucakra is the ecliptic, the path of the sun. The ecliptic cuts the path of the moon into two parts giving Rāhu and Ketu, the imaginary points. They are ranked with planets.

Thus from these purāṇic references, it can be deduced that they had some vague notion of the astronomical basis of the phenomena of eclipses.

1. That a lunar eclipse takes place at full moon and a solar eclipse at new moon has been made clear in the *purāṇas*.

2. The *Liṅga*, *Vāyu*, *Matsya* and *Brahmāṇḍa* say that the abode of Rāhu is evolved out of the circular shadow of earth. Visṇucitti, commentator of *Viṣṇu Purāṇa*, says that Rāhu takes upon himself the shadow of earth to obscure the sun and moon.

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[21] *Alberuni's India*, II p. 113.

[22] *Popular Astronomy*, p. 39.

3. The *Sāmba Purāṇa* clearly states that the sun and moon are not swallowed by Rāhu during eclipses but only concealed. In the case of lunar eclipse Rāhu takes upon himself the shadow of earth to conceal the moon whereas Rāhu himself is the concealing factor of the sun at a solar eclipse.

4. In the *Devī Purāṇa* it has been categorically stated that the lunar and solar eclipses are caused by Rāhu in the form of shadow of earth and moon respectively.

5. The idea that eclipses are caused by the interception or obscuration of the light of a luminous body by another intervening body is found in *Bhāgavata*.

6. Vaṁśīdhara and Viśvanātha Cakravartin, the commentators of *Bhāgavata*, state that eclipses are of the form of concealment to the eyes of the people on earth. (There is no concealment to the luminaries as such).

ASTRONOMICAL TEXTS

The *Vedāṅgajyotiṣa* is one of the earliest extant texts in astronomy. It is available in two recensions viz., the *Ṛgvedic* ascribed to Lagadha and the *Yajurvedic*. In the beginning, the knowledge of astronomy was associated with fixing the proper time for the performance of Vedic rituals.[1] Gradually, the need arose for derivation of rules for accurate computation of the position of the planets. The science of Jyotiṣa came to be broadly classified into three branches viz., *siddhānta*, *saṁhitā* and *horā*.[2] From the 5th century onwards, the evolution of Indian astronomical thought witnessed a galaxy of astronomers like Āryabhaṭa, Varāhamihira, Bhāskara, Brahmagupta and Lalla. It also led to the advent of different systems of astronomy like the *Brāhma* expounded by Brahmagupta, *Audayika* (sunrise) and *Ārdharātrika* (midnight) propounded by Āryabhaṭa and the *Saura* initiated in the *Sūryasiddhānta*.

The development of Indian astronomy was marked by continuous revisions, corrections and changes. Brahmagupta in his *Brahmasphuṭasiddhānta* (1. 2) (A.D. 628) says that since the calculations dealing with planets based on the *Brāhma* system have become erroneous in course of time, he would like to clarify them.[3] In his *Khaṇḍa-*

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[1] *Siddhāntaśiromaṇi*, 1.1.9.
वेदास्तावद् यज्ञकर्मप्रवृत्ता यज्ञाः प्रोक्तास्ते तु कालाश्रयेण ।
शास्त्रादस्मात् कालबोधो यतः स्याद् वेदाङ्गत्वं ज्यौतिषस्योक्तमस्मात् ।।
cf. also *RVJ*. 36, *YVJ*. 3.

[2] *Nāradīya Saṁhitā*, 1.4.
सिद्धान्तसंहिताहोरारूपं स्कन्धत्रयात्मकम् ।
वेदस्य निर्मलं चक्षुर्ज्योतिश्शास्त्रमनुत्तमम् ।।

[3] ब्रह्मोक्तं ग्रहगणितं महता कालेन यत् श्लथीभूतम् ।
अभिधीयते स्फुटं तज्जिष्णुसुतब्रह्मगुप्तेन ।।

khādyaka (1.1.2) Brahmagupta states that Āryabhaṭa's calculation regarding marriage, nativity and the like are impracticable for day to day use and that he intends presenting the same results in a simpler way.[4] The *Parahita* system embodied in Haridatta's *Grahacāranibandhana* (A. D. 683) aimed at simplifying the methods of calculation and to correct the astronomical results arrived at through the *Āryabhaṭīya*. The *Dṛk* system enunciated by Parameśvara in his *Dṛggaṇita* (A.D. 1431) was a revision of the *Parahita* system and promulgated with a view to make the results of the astronomical calculation accord with actual observation.

Eclipses formed one branch of astronomy in which intensive investigations were made. Whenever efforts were directed towards revision, correction and supplementation of the earlier systems of astronomy for arriving at accurate results, eclipses were fully exploited. Parameśvara of *Dṛggaṇita* fame is said to have observed numerous eclipses for a period of fifty years and consulted various texts to arrive at his revised system of *Dṛk*.[5] Nīlakaṇṭha (A. D. 1444) has insisted in his *Jyotirmīmāṁsā* (pp. 1,2,31-36) the need for periodical revision of astronomical parameters through observation. He states that each of the five *siddhāntas* were authoritative at one time. But one always has to look for a system that tallies with observation and this should be verified at the time of eclipses.[6] He has suggested methods for computing and forecasting future eclipses on the basis of the ones actually observed. Thus eclipses being the most convenient natural phenomena were utilized to a major extent in verifying calculations and devising new methodologies.

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[4] प्रायेणार्यभटेन व्यवहारः प्रतिदिनं यतोऽशक्यः ।
उद्वाहजातकादिषु तत्समफललघुतरोक्तिरतः ॥

[5] Nīlakaṇṭha's *Āryabhaṭīyabhāṣya*, 4.48.
परमेश्वराचार्येण पूनर्ग्रहणग्रहयोगादिकं यन्त्रैः पञ्चपञ्चाशद्वर्षकालं सम्यक् परीक्षितम् । .... शास्त्राण्यपि बहून्यालोच्य पञ्चपञ्चाशद्वर्षकालं निरीक्ष्य ग्रहणग्रहयोगादिषु परीक्ष्य समदृग्गणितं करणं चकार ।

The *Vedāṅgajyotiṣa* and *Sūryaprajñapti* of the Jainas do not deal with the methods for calculating eclipses. The *Āryabhaṭīya* (A. D. 476), one of the earliest systematic works on astronomy, gives (4. 37-45) a mathematical interpretation of eclipses in terms of the moon concealing the disc of the sun and the shadow of earth obscuring the moon.

The classics on astronomy like *Brahmasphuṭasiddhānta*, *Khaṇḍakhādyaka*, *Śiṣyadhīvṛddhidatantra*, *Siddhāntaśekhara*, *Sūryasiddhānta* and *Siddhāntaśiromaṇi* deal at length with the methodology for determining both lunar and solar eclipses. Besides, there were also a number of later works exclusively devoted to eclipses, like *Grahaṇāṣṭaka*, *Grahaṇamaṇḍana* and *Grahaṇanyāyadīpikā* by Parameśvara (A.D. 1360-1460), *Grahaṇanirṇaya* by Nīlakaṇṭha (A. D. 1444-1545), *Uparāgakriyākrama* by Nārāyaṇa (C. 1500-1575), *Grahaṇakaumudī* by Pītāmbara Siddhāntavāgīśa (A.D 1576), *Grahaṇamālā* by Hemāṅgada Ṭhakkura (A. D. 1753) and *Grahaṇapaddhati* by Nandarāma Miśra (A.D. 1763). Also sets of astronomical tables for determining the phases, duration and magnitude of eclipses were available in works like the *Parvadvayasādhana* of Mallāri (A.D. 1588), *Grahasāriṇī* of Gaṅgādhara (A.D. 1630), *Karaṇakesarī* of Bhāskara (A.D. 1681), and *Gaṇitarāja* of Kevalarāma Pañcānana (A.D, 1728).

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[6] *Jyotirmīmāṁsā* p. 6.
पञ्चसिद्धान्तास्तावद् क्वचित्काले प्रमाणमेव इत्यवगन्तव्यम् । अपि च यः सिद्धान्तो दर्शनविसंवादी भवति सोऽन्वेषणीयः । दर्शनसंवादश्च तदानीन्तनैः परीक्षकैर्ग्रहणादौ विज्ञातव्यः ।

Astronomers on mythological Rāhu

Alongside these innumerable works on astronomy explaining the method for computing eclipses the popular belief of a demon causing eclipses still continued. It is interesting to note that authors on astronomy have taken cognisance of the mythological aspect of eclipse viz., that of demon Rāhu being the cause, and have discussed this in detail in their treatises. Varāhamihira[7] and Lalla[8], however mention some of the beliefs regarding Rāhu prevalent during their time only to repudiate them. One such belief based on the purāṇic episode speaks of how Rāhu's head though cut off remained alive due to tasting of ambrosia and assumed the form of a planet. But being dark and similar in form to the orbs of the sun and moon it is not visible in the sky except during eclipses due to the boon of the creator Brahmā. Another view is that Rāhu, son of Siṁhikā, is of a serpentine form with only face and tail. Yet another view speaks of the existence of two Rāhus. In addition, Varāhamihira contradicts a few other beliefs of his time that an eclipse is heralded by unusual occurrences (such as earthquake and thunder) and that an eclipse can occur only when there is a combination of five planets (*Pañcagrahasaṁyoga*) in the same zodiacal sign and on the preceding eighth lunar day the direction of the beginning and end of eclipse can be predicted from the behaviour of a drop of oil poured on the surface of water.

In this context it is interesting to note that the earlier *Atharva Pariśiṣṭa* text (53.1.3-2.2) speaks of the omens that announce the coming of Rāhu. The moon trembles, becomes pale and powerless and the spot in the moon increases. The sun throbs, becomes filled with black spots, is surrounded by a halo and there is decrease in the rays. The dogs bark, jackals howl and the crows make circles. Strong winds blow, lightning, thunder, earthquake and fall of meteors appear at dawn and twilight. Water becomes viscid, garlands fade, less of milk is produced from the cows and milk-yielding trees on that day and gems and precious stones become devoid of lustre. These omens could be observed from the eighth day of the dark/bright fortnight upto the new/full moon in the case of solar/lunar eclipses.[9]

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[7] *Bṛhatsaṁhitā*, 5.1-3, 16-17.

[8] *Śiṣyadhivṛddhidatantra*, 2.7. 18-20.

Varāhamihira[10], Lalla[11], and Parameśvara[12] disagreeing with the validity of such beliefs argue thus. If Rāhu is a big serpent who seizes the sun or the moon with his mouth or tail, then why does he not obstruct half of the zodiac lying between his head and tail. If Rāhu is of the form of an orb or has a body, possesses only the head or moves in the zodiac why should he swallow the moon only at a distance of six *rāśis* (from the sun) and not at other intervals (ie. at a distance of two or three *rāśis*). Also if his motion does not confirm to any principle how is it that an eclipse can be determined by calculation. If the existence of two Rāhus to cause solar and lunar eclipse is presumed, then a lunar eclipse occurring when the sun and the moon are 180° apart should also result in a solar eclipse given that both the Rāhus have identical rate of motion.

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[9] Vide also Bhaṭṭotpala's commentary on the *Bṛhatsaṁhitā*, 5. 16.

[10] *Bṛhatsaṁhitā*, 5. 4-7.

[11] *Śiṣyadhīvṛddhidatantra*, 2.7. 21-24.

[12] *Goladīpikā*, 2. 38-40.

the abode of Rāhu is full of darkness and evolved out of the circular shadow of the earth.[15]

Sāmba Upapurāṇa (Ch. 22.12. 13,16,19, 29-35) says that during solar and lunar eclipses the sun and the moon are not swallowed by the demon Rāhu, but only concealed like a cloud. On the new moon day Rāhu (as ordained by the creator) approaches the sun in order to have his share of nectar, *amṛtādbhāgaḥ,* from the moon who is in conjunction with the sun on that particular day. In that process he covers the sun as well as the moon. This is how solar eclipses are caused. Likewise on the full moon day Rāhu approaches the moon with the purpose of drinking nectar and covers it by taking upon himself the shadow of earth and thereby causes lunar eclipse. Thus during eclipse the brilliance of the luminary is not diminished but only covered/concealed for some time. Rāhu is said to approach the moon in the bright fortnight and the sun in the dark fortnight. It has also been stated that eclipses occur only during *parvas.*[16]

In the *Devī Upapurāṇa* (ch. 49) reference is made to lunar and solar eclipses being caused by Rāhu in the form of shadow of the earth and the moon respectively.[17]

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[15] उद्धृत्य पृथिवीच्छायां निर्मितां मण्डलाकृतिम् ।
स्वर्भानोस्तु बृहत्स्थानं तृतीयं यत्तमोमयम् ॥

[16] अतश्छादयते राहुरभ्रवच्छशिभास्करौ ।
राहुरभ्रकसंस्थानं सोममाच्छाद्य तिष्ठति ॥
उद्धृत्य पार्थिवीं छायां धूमान्मेघ इवोत्थितः ।
चन्द्रस्य यदवस्पृष्टं राहुणा भास्करस्य च ॥
तेभ्यावखंडितं तस्य केवलं श्यामलीकृतम् ।
कर्दमेन यथा वस्त्रं शुक्लत्वमपहन्यते ॥

[17] *Studies in Upapūrāṇa*, II. p.51.

Other descriptions of Rāhu

The *Brahmāṇḍa* (1.2.23. 88-91), *Matsya* (127. 9-11), *Vāyu* (1.52. 80-82), *Viṣṇu* (2.12. 21-23) and *Liṅga* (1.57.4) Puraṇas say that eight black or smoke coloured horses draw the dusky chariot of Rāhu. These horses are attached to it forever once they are harnessed. Ketu's chariot is drawn by eight horses of dusky and lac red colour. During *parvas* Rāhu moves from the sun towards the moon and again goes back to the sun from the moon in the solar *parvan*.

The *Brahmāṇḍa* (1.2.24.103b), *Vāyu* (1.53.65b), *Liṅga* (1.61.32) and *Matsya* (128. 63b) speak of the etymology of Svarbhānu as one who pushes or afflicts the heaven by means of his splendour.

In chapter 1.13. 29-31 the *Skanda Purāṇa*, describes the fight between the moon and Rāhu and how Rāhu drank the nectar oozing out from the moon.

The *Liṅga* (1.61.48) and *Brahmāṇḍa* (1. 2. 24. 136b, 137a) say that Rāhu, full of tāmasic vigour, is by nature a dark circular orb, the oppressor of sun and moon and born in the constellation *bharaṇi*.[18] He also causes great distress to living beings.[19]

Influence of Ṛgvedic Svarbhānu

The *Vāyu* (2.9.71-72) and *Brahmāṇḍa* (1.3.8. 77b. 79a) give an altogether different episode of Svarbhānu. Sūrya,

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18 तमोवीर्यमयो राहुः प्रकृत्या कृष्णमण्डलः ।
भरणीषु समुत्पन्नो ग्रहश्चन्द्रार्कमर्दनः ।।

19. *Brahmāṇḍa* 1.2.24.97a; *Liṅga* 1.61.25b; *Vāyu* 1.53.88a; *Matsya* 128.55.

स्वर्भानोस्तामसं स्थानं भूतसंतापनालयम् ।

struck by Svarbhānu was about to fall down from heaven but due to the blessings of the Brahmarṣi (Atri) did not fall down and thus gave light to the world filled with darkness.[20]

This account seems to have leanings towards the Ṛgvedic passage (5.40.5,9) wherein it is stated that Atri restored the sun from the darkness that engulfed it. (See p. 5 above).

Size of Sun, Moon and Rāhu

There are some interesting details about the relative sizes of the sun, moon and Rāhu. The *Vāyu* (1.53.62-64), *Brahmāṇḍa* (1.2.24. 99b-101), *Liṅga* (1.57.10-12) and *Matsya* (128. 57-60) say that the diameter of the sun is nine thousand *yojanas*. The expanse of its *maṇḍala* is thrice that of its diameter. The extant of the moon is twice that of the sun. Rāhu assumes a size equal to them and moves beneath them. The *Bhāgavata* (5.24.2) says that Svarbhānu is situated 10,000 yojanas below the sun and moves like a constellation. The expanse of the sun is described as 10,000, the moon 12,000 and that of Rāhu 13,000 yojanas.

Marīci ṭikā on Eclipses

Viśvarūpa in his commentary on *Siddhāntaśiromaṇi* (p. 296) says that the words like *grāsa* (swallowing) should not be understood in the literal sense since no swallowing takes place during eclipses. But the act of earth's shadow eclipsing the moon and the moon eclipsing the sun is allegorically referred to as swallowing.

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[20] स्वर्भानुना हते सूर्ये पतमाने दिवो महीम् ।
तमोऽभिभूते लोकेऽस्मिन् प्रभा येन प्रवर्तिता ॥
स्वस्ति तेऽस्त्विति चोक्तः स[वै] पतन्निह दिवाकरः ।
ब्रह्मर्षेर्वचनात्तस्य न पपात दिवो महीम् ॥

ग्रासादिशब्दाः स्वपरनये पिधेयस्य गिलनोद्गिलनन्यायेनाकर्षणसाम्येनासुरतृप्तिहेतुत्वादिभिश्च सादृश्योपचारात्सर्वेऽपि गौणा एव ।

He further says that in the Purāṇas though the direct reference is only to Rāhu being the cause of eclipse, it goes without saying that he causes eclipses through the medium of *bhūbhā* (earth's shadow) and moon.

Views of Scholars on Eclipses

Alberuni[21] observes that the paurāṇikas did not have the correct knowledge of eclipses as they had placed the moon above the sun and had to necessarily invent some other being to devour the sun and the moon to cause eclipses.

V. Thiruvenkatacarya[22] says that the story is nothing but an allegorical representation of an astronomical fact and its discovery. The sun is Viṣṇu of the Vedas and Viṣṇucakra is the ecliptic, the path of the sun. The ecliptic cuts the path of the moon into two parts giving Rāhu and Ketu, the imaginary points. They are ranked with planets.

Thus from these purāṇic references, it can be deduced that they had some vague notion of the astronomical basis of the phenomena of eclipses.

1. That a lunar eclipse takes place at full moon and a solar eclipse at new moon has been made clear in the *purāṇas*.

2. The *Liṅga*, *Vāyu*, *Matsya* and *Brahmāṇḍa* say that the abode of Rāhu is evolved out of the circular shadow of earth. Visṇucitti, commentator of *Viṣṇu Purāṇa*, says that Rāhu takes upon himself the shadow of earth to obscure the sun and moon.

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[21] *Alberuni's India*, II p. 113.

[22] *Popular Astronomy*, p. 39.

3. The *Sāmba Purāṇa* clearly states that the sun and moon are not swallowed by Rāhu during eclipses but only concealed. In the case of lunar eclipse Rāhu takes upon himself the shadow of earth to conceal the moon whereas Rāhu himself is the concealing factor of the sun at a solar eclipse.

4. In the *Devī Purāṇa* it has been categorically stated that the lunar and solar eclipses are caused by Rāhu in the form of shadow of earth and moon respectively.

5. The idea that eclipses are caused by the interception or obscuration of the light of a luminous body by another intervening body is found in *Bhāgavata*.

6. Vaṁśīdhara and Viśvanātha Cakravartin, the commentators of *Bhāgavata*, state that eclipses are of the form of concealment to the eyes of the people on earth. (There is no concealment to the luminaries as such).

ASTRONOMICAL TEXTS

The *Vedāṅgajyotiṣa* is one of the earliest extant texts in astronomy. It is available in two recensions viz., the *Ṛgvedic* ascribed to Lagadha and the *Yajurvedic*. In the beginning, the knowledge of astronomy was associated with fixing the proper time for the performance of Vedic rituals.[1] Gradually, the need arose for derivation of rules for accurate computation of the position of the planets. The science of Jyotiṣa came to be broadly classified into three branches viz., *siddhānta*, *saṁhitā* and *horā*.[2] From the 5th century onwards, the evolution of Indian astronomical thought witnessed a galaxy of astronomers like Āryabhaṭa, Varāhamihira, Bhāskara, Brahmagupta and Lalla. It also led to the advent of different systems of astronomy like the *Brāhma* expounded by Brahmagupta, *Audayika* (sunrise) and *Ārdharātrika* (midnight) propounded by Āryabhaṭa and the *Saura* initiated in the *Sūryasiddhānta*.

The development of Indian astronomy was marked by continuous revisions, corrections and changes. Brahmagupta in his *Brahmasphuṭasiddhānta* (1. 2) (A.D. 628) says that since the calculations dealing with planets based on the *Brāhma* system have become erroneous in course of time, he would like to clarify them.[3] In his *Khaṇḍa-*

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[1] *Siddhāntaśiromaṇi*, 1.1.9.
वेदास्तावद् यज्ञकर्मप्रवृत्ता यज्ञाः प्रोक्तास्ते तु कालाश्रयेण ।
शास्त्रादस्मात् कालबोधो यतः स्याद् वेदाङ्गत्वं ज्योतिषस्योक्तमस्मात् ।।
cf. also *RVJ*. 36, *YVJ*. 3.

[2] *Naradīya Saṁhita*, 1.4.
सिद्धान्तसंहिताहोरारूपं स्कन्धत्रयात्मकम् ।
वेदस्य निर्मलं चक्षुर्ज्योतिश्शास्त्रमनुत्तमम् ।।

[3] ब्रह्मोक्तं ग्रहगणितं महता कालेन यत् श्लथीभूतम् ।
अभिधीयते स्फुटं तज्जिष्णुसुतब्रह्मगुप्तेन ।।

khādyaka (1.1.2) Brahmagupta states that Āryabhaṭa's calculation regarding marriage, nativity and the like are impracticable for day to day use and that he intends presenting the same results in a simpler way.[4] The *Parahita* system embodied in Haridatta's *Grahacāranibandhana* (A. D. 683) aimed at simplifying the methods of calculation and to correct the astronomical results arrived at through the *Āryabhaṭīya*. The *Dṛk* system enunciated by Parameśvara in his *Dṛggaṇita* (A.D. 1431) was a revision of the *Parahita* system and promulgated with a view to make the results of the astronomical calculation accord with actual observation.

Eclipses formed one branch of astronomy in which intensive investigations were made. Whenever efforts were directed towards revision, correction and supplementation of the earlier systems of astronomy for arriving at accurate results, eclipses were fully exploited. Parameśvara of *Dṛggaṇita* fame is said to have observed numerous eclipses for a period of fifty years and consulted various texts to arrive at his revised system of *Dṛk*.[5] Nīlakaṇṭha (A. D. 1444) has insisted in his *Jyotirmīmāṁsā* (pp. 1,2,31-36) the need for periodical revision of astronomical parameters through observation. He states that each of the five *siddhāntas* were authoritative at one time. But one always has to look for a system that tallies with observation and this should be verified at the time of eclipses.[6] He has suggested methods for computing and forecasting future eclipses on the basis of the ones actually observed. Thus eclipses being the most convenient natural phenomena were utilized to a major extent in verifying calculations and devising new methodologies.

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[4] प्रायेणार्यभटेन व्यवहारः प्रतिदिनं यतोऽशक्यः ।
उद्वाहजातकादिषु तत्समफललघुतरोक्तिरतः ॥

[5] Nīlakaṇṭha's *Āryabhaṭīyabhāṣya*, 4.48.
परमेश्वराचार्येण पूनर्ग्रहणग्रहयोगादिकं यन्त्रैः पञ्चपञ्चाशद्वर्षकालं सम्यक् परीक्षितम् । .... शास्त्राण्यपि बहून्यालोच्य पञ्चपञ्चाशद्वर्षकालं निरीक्ष्य ग्रहणग्रहयोगादिषु परीक्ष्य समदृग्गणितं करणं चकार ।

The *Vedāṅgajyotiṣa* and *Sūryaprajñapti* of the Jainas do not deal with the methods for calculating eclipses. The *Āryabhaṭīya* (A. D. 476), one of the earliest systematic works on astronomy, gives (4. 37-45) a mathematical interpretation of eclipses in terms of the moon concealing the disc of the sun and the shadow of earth obscuring the moon.

The classics on astronomy like *Brahmasphuṭasiddhānta*, *Khaṇḍakhādyaka*, *Śiṣyadhīvṛddhidatantra*, *Siddhāntaśekhara*, *Sūryasiddhānta* and *Siddhāntaśiromaṇi* deal at length with the methodology for determining both lunar and solar eclipses. Besides, there were also a number of later works exclusively devoted to eclipses, like *Grahaṇāṣṭaka*, *Grahaṇamaṇḍana* and *Grahaṇanyāyadīpikā* by Parameśvara (A.D. 1360-1460), *Grahaṇanirṇaya* by Nīlakaṇṭha (A. D. 1444-1545), *Uparāgakriyākrama* by Nārāyaṇa (C. 1500-1575), *Grahaṇakaumudī* by Pītāmbara Siddhāntavāgīśa (A.D 1576), *Grahaṇamālā* by Hemāṅgada Ṭhakkura (A. D. 1753) and *Grahaṇapaddhati* by Nandarāma Miśra (A.D. 1763). Also sets of astronomical tables for determining the phases, duration and magnitude of eclipses were available in works like the *Parvadvayasādhana* of Mallāri (A.D. 1588), *Grahasāriṇī* of Gaṅgādhara (A.D. 1630), *Karaṇakesarī* of Bhāskara (A.D. 1681), and *Gaṇitarāja* of Kevalarāma Pañcānana (A.D, 1728).

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[6] *Jyotirmīmāṁsā* p. 6.
पञ्चसिद्धान्तास्तावद् क्वचित्काले प्रमाणमेव इत्यवगन्तव्यम् । अपि च यः सिद्धान्तो दर्शनविसंवादी भवति सोऽन्वेषणीयः । दर्शनसंवादश्च तदानीन्तनैः परीक्षकैर्ग्रहणादौ विज्ञातव्यः ।

Astronomers on mythological Rāhu

Alongside these innumerable works on astronomy explaining the method for computing eclipses the popular belief of a demon causing eclipses still continued. It is interesting to note that authors on astronomy have taken cognisance of the mythological aspect of eclipse viz., that of demon Rāhu being the cause, and have discussed this in detail in their treatises. Varāhamihira[7] and Lalla[8], however mention some of the beliefs regarding Rāhu prevalent during their time only to repudiate them. One such belief based on the purāṇic episode speaks of how Rāhu's head though cut off remained alive due to tasting of ambrosia and assumed the form of a planet. But being dark and similar in form to the orbs of the sun and moon it is not visible in the sky except during eclipses due to the boon of the creator Brahmā. Another view is that Rāhu, son of Siṁhikā, is of a serpentine form with only face and tail. Yet another view speaks of the existence of two Rāhus. In addition, Varāhamihira contradicts a few other beliefs of his time that an eclipse is heralded by unusual occurrences (such as earthquake and thunder) and that an eclipse can occur only when there is a combination of five planets (*Pañcagrahasaṁyoga*) in the same zodiacal sign and on the preceding eighth lunar day the direction of the beginning and end of eclipse can be predicted from the behaviour of a drop of oil poured on the surface of water.

In this context it is interesting to note that the earlier *Atharva Pariśiṣṭa* text (53.1.3-2.2) speaks of the omens that announce the coming of Rāhu. The moon trembles, becomes pale and powerless and the spot in the moon increases. The sun throbs, becomes filled with black spots, is surrounded by a halo and there is decrease in the rays. The dogs bark, jackals howl and the crows make circles. Strong winds blow, lightning, thunder, earthquake and fall of meteors appear at dawn and twilight. Water becomes viscid, garlands fade, less of milk is produced from the cows and milk-yielding trees on that day and gems and precious stones become devoid of lustre. These omens could be observed from the eighth day of the dark/bright fortnight upto the new/full moon in the case of solar/lunar eclipses.[9]

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[7] *Bṛhatsaṁhitā*, 5.1-3, 16-17.

[8] *Śiṣyadhīvṛddhidatantra*, 2.7. 18-20.

Varāhamihira[10], Lalla[11], and Parameśvara[12] disagreeing with the validity of such beliefs argue thus. If Rāhu is a big serpent who seizes the sun or the moon with his mouth or tail, then why does he not obstruct half of the zodiac lying between his head and tail. If Rāhu is of the form of an orb or has a body, possesses only the head or moves in the zodiac why should he swallow the moon only at a distance of six *rāśis* (from the sun) and not at other intervals (ie. at a distance of two or three *rāśis*). Also if his motion does not confirm to any principle how is it that an eclipse can be determined by calculation. If the existence of two Rāhus to cause solar and lunar eclipse is presumed, then a lunar eclipse occurring when the sun and the moon are 180° apart should also result in a solar eclipse given that both the Rāhus have identical rate of motion.

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[9] Vide also Bhaṭṭotpala's commentary on the *Bṛhatsaṁhitā*, 5. 16.

[10] *Bṛhatsaṁhitā*, 5. 4-7.

[11] *Śiṣyadhīvṛddhidatantra*, 2.7. 21-24.

[12] *Goladīpikā*, 2. 38-40.

Varāhamihira[13] and Lalla[14] contend that the belief that Rāhu is the cause of eclipses and associated myths are without basis on account of the fact that eclipses are mathematically predictable. Moreover since there are differences with regard to the duration, visibility, size of the obscured body, obscured portion, direction of the first contact etc., they conclude that Rāhu cannot be the cause of eclipses. Varāhamihira maintains this scientific reasoning while disagreeing with the conclusions of the ancient seers endowed with divine insight. Eclipses, he says, cannot be ascertained by omens or portents for they occur at other times as well. Parameśvara[15] however holds that perhaps such eclipses which are not mathematically calculable could be of the nature of *utpātas* (calamitous portents) and Svarbhānu who is said to cause them is the one spoken of in the Vedas.

Reconciliation of the Concept of Rāhu by astronomers

Having refuted the traditional aspect of eclipses, Varāhamihira arrives at a sort of justification of Rāhu.[16]

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[13] *Bṛhatsaṁhitā*, 5.13.
एवमुपरागकारणमुक्तमिदं दिव्यदृग्भिराचार्यैः ।
राहुरकारणमस्मिन्नित्युक्तः शास्त्रसद्भावः ॥

[14] *Śiṣyadhivṛddhidatantra*, 2.3. 34.
ग्रहणे ग्रहमोक्षदिशो रविशशिनोः खण्डकालवैचित्र्यात् ।
शशिभूच्छाये कारणमकारणं राहुरिति सिद्धम् ॥

[15] *Goladipikā*, 2. 44.
गणितानवगम्यं यद्ग्रहणं तूत्पातरूपमाद्योक्तम् ।
तत्कारणवाची वा स्वर्भानुर्वेदनिर्दिष्टः ॥

[16] *Bṛhatsaṁhitā* 5. 14, 15.
योऽसावसुरो राहुस्तस्य वरो ब्रह्मणायमाज्ञप्तः ।
आप्यायनमुपरागे दत्तहुतांशेन ते भविता ॥
तस्मिन्काले सान्निध्यमस्य तेनोपचर्यते राहुः ।
याम्योत्तरा शशिगतिर्गणितेऽप्युपचर्यते तेन ॥

He says, the presence of Rāhu is assumed at the time of eclipse due to the boon of the creator that he shall sustain himself by means of oblations offered to the sacred fire at that time. The moon, he says, has two nodes, northern and southern, of which the ascending node is Rāhu.[17]

Although Brahmagupta gives his theory of eclipses, refutes Varāhamihira and other astronomers like Śrīṣeṇa, Āryabhaṭa and Viṣṇucandra for rejecting the orthodox explanation of the phenomenon found in the Vedas, Smṛtis and Saṁhitās. He questions the scientific view of Varāhamihira, and adds that if this view is accepted, then the performance of *japa*, *homa* and *snāna*, and also the effects of the eclipse described by Garga would prove futile. Further from the statements in the Vedas and Smṛtis it is clear that Rāhu causes eclipses and the performance of rites during that period yield merit.[18] Hence Brahmagupta contends that due to the boon of Brahmā, Rāhu enters the shadow of earth and moon and causes lunar and solar eclipses. He even goes to the extent of saying that it is Rāhu who, being of the same diameter (*vyāsa*) as the shadow of earth and moon, respectively hides the moon and sun during eclipses.[19]

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[17] Alberuni (*Alberuni's India* II. p. 110) observes that the recognition of the mythological Rāhu by Varāhamihira who has already revealed himself as a man who accurately knows the shape of the world, are odd and surprising. However he comments that Varāhamihira does not deserve to be blamed, as on the whole, his foot stands firmly on the basis of truth.

[18] *Brahmasphuṭasiddhānta*, 21. 41.
राहुकृतं ग्रहणद्वयमागोपालाङ्गनादि सिद्धमिदम् ।
बहुफलमिदमपि सिद्ध जपहोमस्नानफलमत्र ॥

[19] *Brahmasphuṭasiddhānta*, 21. 46, 48.
भूच्छायाव्याससमः शशिकक्षायां स्थितः शशिग्रहणे ।
राहुश्छादयतीन्दुं सूर्यग्रहणेऽर्कमिन्दुसमः ॥ (contd.)

Commenting on this view, Alberuni accuses[20] Brahmagupta of shirking the truth and lending support to imposture. Alberuni is unable to understand why Brahmagupta, after accepting the orthodox explanation, begins to calculate the diameter of the moon in order to explain its eclipsing the sun and the diameter of the shadow of earth in order to explain its eclipsing the moon and compute both the eclipses in agreement with the theory of heretics.

Voicing the orthodox view Bhāskara (*Siddhāntaśiromaṇi*, 2.9.9,10)[21] observes that the ancient idea is rejected only by astronomers. Bhāskara and Śrīpati[22] hold the view that Rāhu being present in the moon, and the shadow of earth causes the solar and lunar eclipses respectively.

Viśvarūpa, the commentator on *Siddhāntaśiromaṇi* (p. 294)[23], explains that the shadow of earth and the moon are by nature dark. Svarbhānu or Rāhu is also described traditionally as of the form of *tamas*. Hence there is not much of contradiction between the traditional and scientific ideas. *Karaṇaratna* (3. 11)[24] states that Rāhu (i.e. shadow) is the one who causes lunar eclipse and the moon, the solar eclipse.

भूच्छायेन्दुमतो हि ग्रहणे छादयति नार्कमिन्दुर्वा ।
तत्स्थस्तद्व्याससमो राहुश्छादयति शशिसूर्यौ ॥

[20] *Alberuni's India*, II. pp. 110-13.

[21] दिग्देशकालावरणादिभेदान्न छादको राहुरिति ब्रुवन्ति ।
यन्मानिनः केवलगोलविद्यास्तत्संहितावेदपुराणबाह्यम् ॥
राहुः कुभामण्डलगः शशाङ्कं शशाङ्कगश्छादयतीनबिम्बम् ।
तमोमयः शंभुवरप्रदानात् सर्वागमानामविरुद्धमेतत् ॥

[22] Vide *Mariciṭikā* on *Siddhāntaśiromaṇi*, p. 296.

[23] ननु भूभेन्द्वोरन्धकाररूपतया न तत्र तदागमनाद्वैलक्षण्यं प्रतीयतेत्यत आह-तमोमय इति । अन्धकाररूपः । तथा च रूपैक्यान्न विलक्षणप्रतीतिः इति भावः ।

[24] ग्राहक इन्दुग्रहणे राहुः सूर्यग्रहे चन्द्रः ॥

Astronomers on Eclipses

It is well known that eclipse is an astronomical event in which there is an interception or obscuration of the light of the sun, moon or other luminous body by the intervention of another body either between it and the eye or between the luminous body and that illuminated by it. Viśvarūpa[25] defines *grahaṇa* to be of the form of difference in colour of the disc of the sun/moon produced by a fixed moving object which covers it and makes it still visible. Some of the terms used to designate eclipse are *uparāga* (from the root *rañj* with *upa*), literally 'colouring' or 'darkening', *upaplava* (from the root *plu* with *upa*) meaning 'oppression' and *grahaṇa* from the root *grah, grabh* 'to seize' or 'catch hold of'. The word *graha* is also made use of in the sense of eclipse.

Cause of Eclipses

The moon, while moving around the earth, comes between the sun and the earth thereby hiding the disc of the sun totally or partially. This is a solar eclipse. When the earth comes between the sun and moon obstructing the rays of the sun from falling on the moon it is called a lunar eclipse. The *Āryabhaṭīya* (4.37) describes solar and lunar eclipses as caused by the moon and the shadow of earth respectively.[26] The *Bṛhatsaṁhitā* (5.8)[27] and the

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[25] *Marīciṭīkā* on *Siddhāntaśiromaṇi*, 1.5.1.
चन्द्रसूर्ययोः ग्रहणं नियतचारकपदार्थकृतावरणजनितदर्शनयोग्यबिम्बवैवर्ण्यरूपम् ।

[26] छादयति शशी सूर्यं शशिनं महती च भूच्छाया ।
Cf. *Goladipika*, 2.41.
छादक इन्दुर्भानोः शशिनो महती च भूच्छाया ।

[27] भूच्छायां स्वग्रहणे भास्करमर्कग्रहे प्रविशतीन्दुः ।

Sūryasiddhānta (4.9)[28] state that the lunar eclipse is caused by the entry of the moon into the *bhūcchāyā* or shadow cone cast by the earth, and a solar eclipse by the moon coming below the sun to eclipse it. Besides the words *bhūcchāyā, kṣiticchāyā* and *urvīcchāyā* referring to the shadow cone cast by the earth, the word *tamas* is also widely used in astronomical texts in the sense of earth's shadow cone at moon's distance. Āryabhaṭa[29] states that what is called *chāyā* or shadow is nothing but *tamas* or darkness. The commentator Paramādīśvara[30] explains the word *chāyā* here as *bhūcchāyā* or shadow of earth.

Conditions for the occurrence of eclipses

The solar eclipse occurs on *amāvāsya* or new-moon day ie., when the moon is in conjunction with the sun. The lunar eclipse occurs at *pūrṇimā* or full-moon day when the full bright disc of the moon is turned towards the earth opposite to that of the sun.[31] According to Vṛddhagarga Rāhu catches hold of the moon at the conjunction of *pūrṇimā* (full moon) and *pratipad* and the sun at the conjunction of *darśa* (new moon) and

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[28] छादको भास्करस्येन्दुरधःस्थो घनवद्भवेत् ।
भूच्छायां प्राङ्मुखश्चन्द्रो विशत्यस्य भवेदसौ ॥

[29] *Āryabhaṭiya*, 4. 37.
...छायापि या तमस्तद्धि ।

[30] On Āryabhaṭiya, 4.37.
तस्या भूमेर्या छाया भूच्छायाख्या सा हि तमः ।
According to lexicons like *Abhidhanacintamaṇi* 2.60 and *Abhidhānaratnamalā* 1. 110 *tamas* is a synonymn of *bhūcchaya*.

[31] *Brahmasiddhanta* q. by Bhaṭṭotpala on *Bṛhatsaṁhitā*, 5. 11.
भूच्छायेन्दुं चन्द्रः सूर्यं छादयति मानयोगार्धात् ।
विक्षेपो यद्यूनः शुक्लेतरपञ्चदश्यन्ते ॥

pratipad.[32] But there is no eclipse of the sun every new moon day and that of the moon every full moon day.[33] The moon must be either at or near one of the two nodes of her orbit for an eclipse to occur. In other words, there can be an eclipse of the sun or moon only when the sun and moon form a conjunction or opposition on or close to the nodes. Eclipses cannot occur when the sun and moon are widely separated from the node. The *Āryabhaṭīya* 4.38[34] says that when at the end of a lunar month, the moon being in the proximity of a node enters the sun, or at the end of a lunar fortnight enters the earth's shadow, it is more or less the middle of an eclipse *(grahaṇamadhyam)* viz., solar eclipse in the former case and lunar eclipse in the latter case.

The *Sūryasiddhānta* (4.6) says that when the longitude of the moon's node is the same as that of the shadow or of the sun, or when it is a few degrees greater or less, there will be an eclipse.[35] Varāhamihira (*Bṛhatsaṁhitā* 5.10) says that when the moon in her course towards the east, tenanting the seventh house from the sun does not swerve much either to the north or the south ie., when its declination is very little, it enters the earth's shadow.[36]

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[32] Q. in *Samayamayūkha*, p. 77.
पूर्णिमाप्रतिपत्सन्धौ राहुः संपूर्णमण्डलम् ।
ग्रसते चन्द्रमर्कं च दर्शप्रतिपदन्तरे ॥

[33] Vide *Siddhantaśekhara*, 7.1.

[34] स्फुटशशिमासान्तेऽर्कं पातासन्नो यदा प्रविशतीन्दुः ।
भूच्छायां पक्षान्ते तदधिकोनं ग्रहणमध्यम् ॥

[35] भानोर्भार्धे महीच्छाया तत्तुल्येऽर्कसमेऽपि वा ।
शशाङ्कपाते ग्रहणं कियद्भागाधिकोनके ॥

[36] सूर्यात्सप्तमराशौ यदि चोदग्दक्षिणेन नातिगतः ।
चन्द्रः पूर्वाभिमुखश्छायामौर्वीं तदा विशति ॥

Nodes

Nodes (*pātas*) are imaginary points where the moon's orbit (around the earth) cuts the ecliptic. They have been conceived as a means to compute the true motion of the planets. They are not visible in the sky.[37] The point at which the moon crosses the sun's path in its passage from south to north is called the north node/ascending node. And the point at which the moon intersects the ecliptic in its passage from north to south is called the south node/descending node.[38]

The terms Rāhu and Ketu are also made use of with reference to nodes or *pātas*. Rāhu and Ketu are said to be personifications of the ascending and descending nodes.[39] The other synonyms[40] of Rāhu like *vidhuntuda* (the troubler of moon), *agu* (destitute of rays), *asura*

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37. *Sūryasiddhānta*, 2. 1.
अदृश्यरूपाः कालस्य मूर्तयो भगणाश्रिताः ।
शीघ्रमन्दोच्चपाताख्या ग्रहाणां गतिहेतवः ॥
Sūryadevayajvan on *Āryabhaṭiya*, 1. 4.
क एते उच्चपाताः येषामत्र भगणोपदेशः क्रियते । उच्यते । तेषामेव ग्रहाणां स्फुटगत्यादिपरिज्ञानोपायभूताः केचन संख्याविशेषाः । नैषां व्योम्नि दर्शनमस्ति । तथा च ब्रह्मगुप्तः (ब्रह्मस्फुटसिद्धान्तः 21.30) -
प्रतिपादनार्थमुच्चं प्रकल्पितं ग्रहगतेस्तथा पातः ।

38. Vide *Sūryasiddhānta*, 2.6,7; *Bṛhatsaṁhitā*, 5.15.

39. *Gūḍharthaprakāśika* on *Sūryasiddhānta*, 2.6.
पातस्थानाधिष्ठात्री देवता राहुः जीवविशेषश्चन्द्रपातस्तु दैत्यविशेषो राहुः ।

40. *Amarakośa* with *Amarapadapārijāta*, 1.3.26.
तमस्तु राहुः स्वर्भानुः सैंहिकेयो विधुन्तुदः ॥
स एव ग्रहकल्लोलः स एवाभ्रपिशाचकः ।
Bṛhajjātaka, 2.3.
राहुस्तमोऽगुरसुरश्च शिखीति केतुः ...॥

(demon) etc. are also used in this sense in astronomica texts.

The terms dragon's head and dragon's tail which is made use of to refer to the nodes were derived from the ancient Chinese conception which regarded the course of the moon as following the coils of a snake[41], the head being originally in the constellation answering to the sign scorpio (Draconis) and the tail in the opposite part of the heavens.[42]

Varāhamihira (*Bṛhatsaṁhitā* 11.2-4) defines Ketu as a comet. According to *Nāradīyasaṁhitā* 2.9.1 and *Bṛhatsaṁhitā* 11.2, there are three types of Ketus—celestial, atmospheric and terrestrial.

Direction of eclipses

The *sparśa* or *pragrahaṇa* or first contact in the case of a solar eclipse takes place in the west and in a lunar eclipse in the east. According to Varāhamihira, the reason for a lunar eclipse not beginning at the western limb is that in a lunar eclipse the moon moving eastward contacts the earth's shadow. Hence the first contact occurs at the eastern limb of the moon and the separation takes place in the west. In a solar eclipse, the moon contacts the sun at its western limb. Hence the first contact does not occur at the eastern limb of the sun but in the western limb and the separation in the eastern limb.[43]

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[41] Vide *Bṛhatsaṁhitā*, 5.3.

मुखपुच्छविभक्ताङ्गं भुजङ्गमाकारमुपदिशन्त्यन्ये ।

Vide also Vīrabhadra and Vaśiṣṭha q. by Bhaṭṭotpala on *Bṛhatsaṁhitā*, 5.3.

सिंहिकातनयस्यास्य राहोः पुच्छमुखादृते ।
नान्यदस्ति परं बाहुकटिपादकरादिकम ॥
भषट्कान्तरितौ राहुः सूर्याचन्द्रमसावुभौ ।
छादयत्युरगाकारो वरदानात्स्वयम्भुवः ॥

[42] *Eclipses in Theory and Practice*, p. 10.

Visibility of the solar and lunar eclipses

The solar eclipse is not visible at all places on the earth, the reason being that the moon's disc which covers the sun is much smaller than the sun. Since the moon's disc cannot hide the sun from all observers on the surface of the earth, a solar eclipse is total or annular for some observers, partial for some and not visible for the rest. The lunar eclipse is of the same nature viz. partial or total to all observers on the earth turned towards the vertex of the shadow cone. (Vide. *Pañcasiddhāntikā* 15.8,9; *Goladīpikā* 4.60,61; *Śiṣyadhīvṛddhidatantra* 2.3.30,33; 2.7.26) Varāhamihira (*Bṛhatsaṁhitā* 5.11, 12) and Bhāskara (*Siddhāntaśiromaṇi* 2.9.1,7,8) say that the moon situated below and moving from the west obstructs the solar disc like a cloud. Hence the solar eclipse is different in different countries according to the visibility of the eclipsed disc. And the duration of the solar eclipse is shorter. The obstructing agency is very large in a lunar eclipse whereas it is small in a solar eclipse. Hence the luminous horns become blunt and sharp respectively in semi-lunar and semi-solar eclipses.

Types of Eclipses

The solar eclipse is of three types, viz., total *(pūrṇa)*, partial *(khaṇḍa)* and annular *(valaya* or *kaṅkaṇa)*.

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[43] *Pañcasiddhāntikā*, 6.14.

स्वे भूच्छायामिन्दुः स्पृशतः स्पृश्यते न पश्चार्धे ।
भानुग्रहेऽर्कमिन्दोः प्राक् प्रग्रहणं रवेर्नातः ॥

cf. *Goladipikā* 2.39, 42; *Śiṣyadhivṛddhidatantra* 1.5.29;2.3.29, 32; *Sūryasiddhānta* 6.4.

When the obscured portion is greater than the obscured body there is total eclipse but if it is less there is partial eclipse. Lalla (*Śiṣyadhīvṛddhidatantra* 1.5.10) says that the shadow (of the earth) is the one that obscures the moon in a lunar eclipse and the moon is the one that obscures the sun in a solar eclipse. Eclipses are total or partial depending upon whether the obscuration is of the whole or part of the eclipsed body.

When the sun is at its maximum distance from the earth and the moon nearer to the earth, the disc of the moon will look bigger and would be able to hide the sun's disc completely. In this case the eclipse is total. When the sun is nearer and the moon is farther away the sun's disc appears larger and the moon's disc smaller. As a result, only the central portion of the sun's disc is hidden leaving the rim or the outer circular ring of the sun visible. This is called an annular or ring eclipse. When the earth passes through only a part of the lunar shadow cone, there is partial solar eclipse.

The lunar eclipse is of two types viz., partial and total. Since the section of the shadow cone cast by the earth is much broader than the moon's disc, a lunar eclipse can only be partial or total but never annular. The lunar eclipse is total when the entire disc of the moon is within the umbra of the shadow cone cast by the earth. The moon is in partial eclipse if only a part of the disc is in the umbra and thus darkened. Brahmagupta *(Khaṇḍakhādyaka* 1.4.3) says that when the *vikṣepa* (latitude) of the moon is subtracted from half of the sum of the diameters of the obscuring and obscured bodies, the remaining is the portion obscured by the shadow. If the obscured portion is greater than the obscured body, there is total eclipse, if less, there is partial eclipse.[44]

Classification of eclipses according to Varāhamihira

Varāhamihira *(Bṛhatsaṁhitā* 5.43-52) classifies eclipses into ten kinds on the basis of the appearance or the behaviour of the shadow in different parts of the solar or lunar disc. When the shadow is on the southern side of the solar or lunar orb it is called *savya* and it is *apasavya* when the eclipse occurs on the northern side of the disc. When the eclipsed disc is enveloped all round as if licked by the tongues of darkness it is *leha.* If a part of the disc is covered by shadow it is called *grasana* (swallowing), and it is *nirodha* when the eclipse starting all around forms a lump of darkness in the middle. *Avamardana* (crushing) takes place when the eclipse is total, and *ārohaṇa* (mounting) when after the termination of eclipse the luminary is again covered by darkness. The eclipse is called *āghrāta* when the shadow appearing on a part of the disc is like the vapours of the hot breath of the mouth on a mirror and *madhyatamas* when the shadow appears in the centre of the disc. It is called *tamo'ntya* when the shadow is thick at the edges and thin in the central portion. Parāśara calls it *upaplava.* (Vide Bhaṭṭotpala on *Bṛhatsaṁhitā* 5.52)

Varāhamihira (*Bṛhatsaṁhitā* 5.81-90) also speaks of ten kinds of *mokṣa* or end of eclipse viz., *dakṣiṇahanu* (breaking of the southern or right chin), *vāmahanu* (breaking of the northern or left chin), *dakṣiṇakukṣibheda* (break of the right belly), *vāmakukṣibheda* (break of the

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44. विक्षंप संशोध्य प्रमाणयोगार्धतस्तमश्छन्नम् ।
सर्वंग्रहणं ग्राह्यादधिके खण्डग्रहणमूने ॥
Cf. also *Sūryasiddhānta* 4. 10, 11.

1501
राष्ट्रिय संस्कृत संस्थान
जयपुर परिसर, जयपुर
पुस्तकालय
क्रमांक..........

left belly), *dakṣiṇapāyubheda* (break of the southern or right anus), *vāmapāyubheda* (break of the left anus), when the release occurs in the south east, south, north, south west and north west respectively. When the commencement and end of eclipse take place on the eastern side of the disc it is *sañcardana* (vomiting). When the beginning is on the eastern side and liberation on the western side it is *jaraṇa* (decaying). *Madhyavidaraṇa* (clearing in the middle) takes place when the liberation starts from the middle of the disc. When darkness is in the middle and brightness appears all round it is *antyavidaraṇa* (piercing at the end).

Colour of Eclipse

Texts on Astronomy speak of the change of colour that occurs in the course of an eclipse, thus throwing light on the minute and accurate observations that might have been carried out through a considerably long period. The earliest available reference to the change of colour in the sun's disc during the progress of a solar eclipse occurs in the Brāhmaṇas (*supra* pp. 13, 14). According to the *Grahalāghava* (6. 6) the solar eclipse is always black in colour.

Texts like *Āryabhaṭīya* (4. 46), *Khaṇḍakhādyaka* (2.4.17), *Śiṣyadhīvṛddhidatantra* (1.5.36), *Siddhāntaśiromaṇi* (1.5.36) and *Grahalāghava* (6.6) speak of the colour-change in the disc of the moon in the course of a lunar eclipse. The obscured part of the moon would be of smoky colour both at the beginning and end of eclipse. It is black when nearly half of the disc is obscured. When more than half of the disc is obscured the moon is dark red. It is tawny when the entire disc is completely obscured.

Varāhamihira in his *Pañcasiddhāntikā* (6.9) says that the moon would be red or brown in colour depending upon whether it is farther or nearer the earth respectively. The moon would be smoky in colour when the eclipse is near sunrise or sunset. The moon has the colour of a rain-cloud when the eclipse is partial.

Eclipses and its predicted effects

From ancient times, eclipses were considered to be portents presaging dreadful events by all the civilizations of the world.[45] In China, the principal ministers of the board of astronomy Hsi and Ho were sentenced to death for having failed to predict a solar eclipse.[46] The *Atharva-Pariśiṣṭa* (chapter 53, *Rāhucāra*) speaks of the good and evil effects of solar and lunar eclipses. The *Nāradīya Saṁhitā* (2.8. 4-8) speaks of the effects of eclipses occurring in the seven *parvas* presided over by the deities Brahmā Indu, Indra, Kubera, Varuṇa, Agni and Yama, as also those occurring earlier or later than the calculated time.

Bṛhatsaṁhitā (5. 20-98) discusses the effects of eclipses that take place in the twelve houses beginning with *meṣa* presided over by natal stars, effects of the various colours of the eclipsed disc, the aspects of different planets on the eclipsed disc, effects of eclipses occurring in the twelve lunar months, effects of ten kinds of eclipses, effects of the shadow appearing in the different parts of the lunar or solar disc and also when the eclipses are partial or total when they occur at summer or winter solstice or take place in one and the same month.[47]

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[45] Regarding historical eclipses, vide *Encyclopaedia Britannica*, VI. pp. 195-96; *Encyclopaedia of Religion and Ethics*, X. pp. 368-69; *Eclipses in theory and practice*, pp. 32-41.

[46] *The texts of Confucianism*, I. pp. 81·82.

[47] Vide Appendix.

In retrospect we may note the following highlights arising from our brief analysis of materials available in Sanskrit astronomical texts —

1. Scientific computations and calculations of eclipses go back to the 5th cent A.D.

2. With the exception of Brahmagupta, other writers have mostly refuted demon Rāhu being the cause of eclipse.

3. Astronomers like Varāhamihira however, have compromised their scientific stand with the mythological views by stating that the head of Rāhu stands for the ascending node.

4. There is a wide usage of Rāhu and Ketu in the sense of ascending and descending nodes. But Ketu is a comet according to Varāhamihira.

5. Astronomers like Brahmagupta, Bhāskara and Śrīpati have acknowledged the presence of Rāhu in the moon and the shadow of earth to cause solar and lunar eclipses respectively.

6. The term *tamas* is a technical term used in astronomical texts in the sense of the shadow of earth.

7. The influence of the mythological concept of eclipses is seen predominant in the usage of terms like *grahaṇa*, *upaplava*, *graha*, *grāsa*, *pragrahaṇa*, *grāhya*, *grāhaka*, *mukha*, *vaktra*, *puccha* etc.

8. Description of the different kinds of eclipses, the colour-change that occurs in the eclipsed disc in the course of an eclipse, speak of the minute, careful and accurate observations, carried out for a considerable time.

ECLIPSE AND RITUALS

Some of the practices followed during eclipses are bathing, fasting, putting *darbha* grass on cooked food, offering oblations to the manes and prayers. Wearing band (*paṭṭa*) on the forehead and offering it to brāhmaṇas afterwards is prescribed for one in whose natal star the eclipse occurs. Besides, there are certain activities forbidden during eclipse like — indulging in sex (*maithuna*), studying or recitation of Vedas etc.

Bathing (Snāna)

The *Dharmaśāstra* texts insist that persons of all the four *varṇas* should bathe daily (*nitya-snāna*). *Snāna* is of course an essential preliminary to *japa, homa* and other rites. It is said that a person who has not taken bath is unfit to perform any auspicious thing. *Snāna* at *grahaṇa* belongs to the *naimittika* type viz., that which is performed on certain occasions.[1]

The *Dharmaśāstras* refer to the period of eclipse as *sūtaka* and *āśauca*. But what type of impurity is present during eclipse is not explained in the texts. It is said that men of all castes (*varṇas)* become impure on seeing Rāhu.[2] Hence they should bathe first and do the prescribed rituals.[3]

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[1] According to *Śaṅkhasmṛti* (VIII. 1) *snāna* (bathing with water) is of six types viz., *nitya*, *naimittika*, *kāmya*, *kriyāṅga*, *malakarṣaṇa* and *kriyā*.

[2] It is noteworthy that the Eskimos of the lower Yukon turned all the pots, wooden buckets and dishes upside down to avoid the unclean subtle essence that descends on earth during eclipse. (*Ency of Rel & Ethics*, X p. 369).

[3] *KV*. p. 533, *BSM*. p.78, *VKK*. pp. 100-1.
सर्वेषामेव वर्णानां सूतकं राहुदर्शने ।
स्नात्वा कर्माणि कुर्वीत...... ॥ (contd.)

Snāna is prescribed at the beginning of the eclipse ie. *sparśakāla* (*grasyamāne bhavet snānam*) and again after the eclipse is over i.e. *mukti (mukte snānam vidhīyate)*. (*CVC*. III.2. p. 390, *SMP*. p. 273).

Bathing during an eclipse is not only to ward off the possible evil effects, but is also recommended as a positive means of achieving merit. The Dharmaśāstra texts (*CVC*. III.2. pp. 383, 387; *KV*. p. 523, *BSM*. p.77) state that *snāna* during eclipses makes one rid of all sins and yield everlasting merit. Some of these statements are of course to be regarded as *arthavādas* praising *snāna* during eclipse and need not be taken in the literal sense. As is usual in such instances, the one who does not take bath at eclipse is much depreciated. For example, such a person is said to suffer from leprosy for seven future lives. (*BSM*. p. 77, *SMP*. p. 272). Even persons who are considered impure owing to a birth or a death (*sūtaka, mṛtaka* and *āśauca*) should take bath during solar / lunar eclipse. If not, it is said that they will die. (*CVC*. III. 2. p. 390, *KV*. pp.527-28, *VKK*. p. 108). Regarding the question as to how persons who are already impure due to birth or death of a person are permitted to do acts like *japa, dāna* and *śrāddha* the *Kālaviveka* (p.533)[4] states that they are declared *śuddha* only till the end of eclipse; thereafter, they again become *sūtaka* / *mṛtaka*.

Snāna is not generally prescribed for women in their menstrual periods. The *Samayamayūkha* (p. 78) says that even they could take bath at eclipses but the prohibition is that they should not bathe in a river, well or tank

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SMP. p. 272, *VSP*. p. 113.
आशौचं जायते नृणां ग्रहणे चन्द्रसूर्ययोः ।
राहुस्पर्शे द्वयोः स्नात्वा...... ॥

4. कर्तुस्तात्कालिकी शुद्धिः अशुद्धः पुनरेव सः ।

directly. They could bathe with the water stored in a container.

Generally one should take bath in cold water during eclipses. But *snāna* in hot water is permitted for the old, sick and children. (*GP*. I.p. 591, *SMP*. p. 271, *BSM*. p.77).

Much emphasis is laid in the Dharmaśāstra texts on seeing an eclipse (*rāhudarśana*) since the *puṇyakāla* in the case of eclipses is said to last as long as the eclipse is visible to the eye.[5] Further the statements like - *muktim dṛṣṭvā tu bhuñjīta snānam kṛtvā* (*CVC*.III.2. p. 380, *VSP*. p. 119), *śrāddham vai rāhudarśane* (*CVC*. III.2. p. 386, *BSM*. p. 78, *VKK*. p. 93, *VSP*. p. 112), *snānam dānam tapah śrāddham anantam rāhudarśane* (*CVC*. III.2. p. 387, *NS*.I .p. 306, *VSP* p. 112), assert that *snāna* and other prescribed acts are to be performed during the period in which the eclipse can be seen. The *Nirṇayasindhu* (I.p. 306) quoting *Kalpataru* says that if only knowledge were to be derived from observation, then one need not take bath or do any acts when the sun / moon are covered by clouds. Hemādri (*CVC*. III.2. p. 388) argues that if actual seeing is intended, then it is an impossible condition since Manu (IV. 37) prohibits direct viewing of the sun during eclipse. The result would be that one would not take bath or do the prescribed acts when the eclipse is really on. But the *śiṣṭas* do observe bath etc. even when they do not actually see the eclipse. Hence according to him, the *puṇyakāla* lasts as long as the eclipse is deduced to last as per astronomical calculations. According to *Kālaviveka* (pp. 528-29) if it is argued that it is only the occurrence of eclipse and not its viewability that is relevant then one may have to undergo a bath etc. when the eclipse could be viewed only in some other country. *Vīramitrodaya* (*samayaprakāśa*, p. 126)[6] therefore contends that *snāna* etc. are to be performed when one knows from the *śāstra* that the eclipse can possibly be observed in a particular country even though one may not actually see it. The *Dharmasindhu* (p. 61) states that the appropriate time for the performance of *snāna* and *dāna* could be known from the *jyotiṣa* texts wherein is given the calculation for the *sparśa* and *mokṣakālas*. Thus, on consideration of the various views, it emerges that the performance of rites is prescribed for the country where the eclipse would occur, whether visible or concealed by clouds.

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[5] *SMP*. p. 273.

राहोस्तु दर्शनं यावत्पुण्यकाल उदाहृतः ।
चन्द्रसूर्योपरागे तु यावद्दर्शनगोचरः ॥

Regarding the place of taking bath, it was considered meritorious to do *snāna* at holy rivers like Godāvarī, Narmadā, Sarasvatī, Prayāga and Puṣkara (*CVC*. III.2. pp. 384-86). *Snāna* in Ganges during eclipse is said to carry great benefits.[7] The *Devīpurāṇa* (ch. 73) specifies certain *tīrthas* deemed sacred for eclipses occurring in specific months. If no holy place is available, then one could take bath in a *vāpī, kūpa, taḍāga* or *giriprasrava* i. e. a tank, well, pond or mountain-stream.

According to *Gadādharapaddhati* (I. p. 598), the following are the verses to be recited while taking bath at the beginning of eclipse and after *mukti* (release), respectively—

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[6] समाने देशे चाक्षुषत्वयोग्यमुपरागं शास्त्रतो ज्ञात्वा तत्तत्काले स्नानादि कुर्यात् ।

[7] *CVC* III.2. p. 385, *KV* p. 522, *VKK*. p. 112.

चन्द्रसूर्यग्रहे चैव योऽवगाहेत जाह्नवीम् ।
स स्नातः सर्वतीर्थेषु............ ।।

स्वस्थानं गम्यतां राहो त्यज्यतां चन्द्र(सूर्यं)सङ्गम: ।
परमचाण्डालयोने त्वं मम पापक्षयं कुरु ।।
यथापदो विमुक्तोऽसि राह्वोर्वंदनसङ्कटात् ।
तथा त्वं रोहिणीनाथ आपदो मां विमोचय ।।

Though bath, gifts, prayer and *homa* are generally forbidden at night, eclipses were considered an exception, says *Parāśara Smṛti* (II. 12. 21b, 22)[8]. He is of the view that but for eclipses *snāna* at night is not advisable.

Fasting

One is not supposed to eat during eclipses. The *Dharmaśāstras* prescribe that one should take food only after the eclipse is over and after taking a bath (*CVC*. III.2. p. 379). In case the sun or moon has already set before being freed from eclipse, then one should take a bath; but only on seeing its rise on the next day should one partake food (*CVC*. III.2. p. 379, *KV*. p. 537, *VKK*. p. 104). The *Kālaviveka* (p. 543) quoting Dhavala says that in the case of *grastāstamītacandra, snāna* and *dāna* could be done but *bhojana* is prohibited till *candrodaya*.

Opinions vary regarding the time from which one ought to start fasting. The period of four *praharas* before solar eclipse and three *praharas* before lunar eclipse was called *vedha-kāla* (*DS*. p. 67). Vṛddha Gautama (q by *CVC*. III.2. p. 381, *NS*. I. p. 282) states that one should not eat for three *yāmas / praharas* (nine hours) in the case of lunar eclipse and for four *yāmas / praharas* (twelve hours) in the case of solar eclipse. According to Bhojadeva (q. by *KV*. p.539), one should not eat during the day for solar eclipse and in the evening for lunar eclipse. Mārkaṇḍeya (q. by *CVC*. III.2. p. 381) states that if the eclipse occurs in the evening then one should stop eating by afternoon; if it occurs in the afternoon, then one should not partake food after mid-day or noon; and if at noon, then one could partake food till *saṅgava* (the second of the five divisions of the day). But in the case of eclipse occurring at *saṅgava*, *bhojana* is prohibited before eclipse. All texts agree with the breaking of fast after seeing the release. Here again, there is no *bhojananiṣedha* (prohibition for taking food) in the case of sick, old, women and children (*CVC*. III. 2. p.381). Also it is stated that *upavāsa* (fasting) is not needed for a householder with a son (*CVC*. III.2. p. 382).

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[8] अप्रशस्तं निशि स्नानं राहोरन्यत्र दर्शनात् ।।
स्नानं दानं जपो होम: कर्तव्यो राहुदर्शने ।
अन्यदा त्वशुची रात्रिस्तस्मात्तां परिवर्जयेत् ।।

Food already cooked should be avoided (SMP. p. 272). But certain things like ghee, pickles, milk and curd could be made use of by putting *kuśa* grass[9]. According to Vṛddha Manu (q. by *SMP*. p. 450)[10], *āranāḷa* (sour gruel made from the fermentation of boiled rice), buttermilk, oil, water and food cooked with ghee could be made use of after eclipse, by placing bits of *kuśa* in them.

Darbha[11] grass is considered very sacred and is invariably used in all Hindu rituals and worship[12]. In rituals it is chiefly used as a purificatory agent. *Darbha* grass also possesses certain medicinal properties. In *āyurveda*, *darbha* as well as *kuśa* belong to the *tṛṇapañcamūla* category[13]. *Darbha* is said to be an appetiser and di-uretic, beneficial in cases of fever, jaundice, hiccup, stone in bladder, pain in rectum etc. It forms an ingredient in certain *āyurvedic* preparations like *tṛṇapañcamūlakvātha* and *pañcatṛṇakṣīra* (prescribed for *mūtrakṛcchra*)[14]. It may be due to the medicinal properties that *darbha* is sprinkled on food items during eclipse so that it may not get spoilt.

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[9] *DS*. p. 66.
घृते संधिते गोरसेषु ग्रहणकाले कुशान्तरायं कुर्यात् ।

[10] आरनाळं च तक्रं च पाथेयं घृतपाचितम् ।
उदकं च कुशच्छन्नं न दुष्येद्राहुसूतके ।।

[11] Kātyāyana q. by *SMP*. p. 231.
Darbha is one from which no further blades shoot forth; blades from which fresh sprouts come forth are called *kuśa*. Blades with roots are called *kutapas* and the blades with the tip cut off are called *tṛṇa*.

[12] The Vedas speak of the sanctity of *darbha* grass. *Pavitram vai darbhāḥ punātyaivainam* (*Tai*. *Br*. 1. 3. 7. 1.). According to (contd.)

The *Smṛtimuktāphala* (p.450) quoting *Smṛtiratna* states that certain items like oil, milk, curd, flour etc., never get spoilt during eclipses.[15]

Much is spoken of regarding the merits accrued by the person who gives up food during eclipse. It is stated that one will be rid of all sins and get everlasting merit (*CVC*. III.2. p. 383, *KV*. p. 524, *BSM*. p. 80). Also, one who gives up food for three nights, takes bath and gives *dāna* will attain salvation (*CVC*. III.2. p. 384).

The expiation (*prāyaścitta*) for one who takes food on the day of eclipse, is fasting for three days according to

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Atharvaveda (19.28.4) it is worn as an amulet for protection from enemies and for prolonged life. The *Kūrma Purāṇa* (2.18.51) says that any rite performed without *darbha* will yield no result.

[13] *Bhaiṣajyaratnāvalī* 4.34.
कुशः काशः शरो दर्भं इक्षुश्चैव तृणोद्भवम् ।
पञ्चतृणमिदं ख्यातं तृणजं पञ्चमूलकम् ॥

[14] *Loc. cit.* 23. 18; 34. 20, 21.

[15] आरनालं तथा क्षीरं कन्दकं दधिसक्तवः ।
स्नेहपक्वं च तैलं च न कदाचित्प्रदुष्यति ॥

Kātyāyana Smṛti and *Saṭtriṁśanmata* (q. by *CVC*. III.2. p. 382, *NS*. I. p. 286, *VKK*. p. 106). *Prājāpatya*, a special *vrata*, [16] is to be performed by a person who takes food during eclipse (*CVC*. III.2. p. 382, *BSM*. p. 80, *VKK*. p. 106).

Our energies are mainly derived from the sun. The cosmic energy we receive from the sun is suddenly shut out at the time of eclipse.[17] Hence fasting before and during eclipse was perhaps advocated on grounds of health. K.V. Thiruvenkatacharya [18] is of the view that during eclipses, the benign solar influence reaching us through the rays and magnetic waves are intercepted abruptly. Hence great care is to be taken to preserve the equilibrium of the physical and mental conditions. For this reason, empty stomach is advocated during the period of eclipse so that there may be very little strain on our digestive system during the period of tension.

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[16] According to Manu (XI. 210) *prājāpatya-vrata* consists in taking only one morning meal, one meal in the evening, subsisting on alms obtained without begging and total fasting successively for three days each.

त्र्यहं प्रातस्त्र्यहं सायं त्र्यहमद्यादयाचितम् ।
त्र्यहं परं च नाश्नीयात्प्राजापत्यं चरन्द्विजः ॥

[17] Interestingly, the *Encyclopaedia Britannica* (VI. p. 193) refers to a 'corpuscular eclipse', which sets in hours before the optical solar eclipse. It is stated there that during a solar eclipse, the Ionosphere, a region in the earth's upper atmosphere, undergoes a change as the ultra-violet radiation and the x-radiation of the sun is cut off. Further the solar wind (consisting of continuous emissions of charged particles or corpuscles from the sun) is also screened from the earth during the eclipse of the sun. This is the corpuscular eclipse; its effects should be felt much earlier than the visual eclipse. However no certain evidence of a corpuscular eclipse has been found since such observations are to be done only outside the atmosphere.

[18] *Popular Astronomy*, p. 47.

Śrāddha

All *dharmaśāstra* texts unanimously prescribe performance of *śrāddha* at the time of eclipse. *Śrāddha* performed during eclipse comes under the *naimittika* category (*SMP*. p. 757). Generally *kṛṣṇapakṣa* is associated with *pitṛs*. So it is said that *śrāddha* should be performed at *sparśa-samaya* (i.e. beginning) in solar eclipse when there is still *kṛṣṇapakṣa* and at the end in lunar eclipse when *kṛṣṇapakṣa* would begin. If it so happens that the regular *pitṛśrāddha* falls on the day of eclipse, then it is to be performed the next day.[19]

There are generally certain times[20] prescribed for performing *śrāddha*. *Manusmrti* (III. 280) says, that a *srāddha* performed at night is called *rākṣasī*. Hence *śrāddha* is not to be done at that time. But though there is prohibition for *śrāddha* at *sandhyā* and *rātri*, eclipses are an exception. *Grahaṇa* is said to be one of the most ideal time to perform a *śrāddha* and performance of *śrāddha* is compulsory at eclipse (*Yāj*. I. 215, *KV*. p. 527, *VKK*. p. 93, *SMP*. p. 760). *Snāna*, *dāna*, *japa* and *śrāddha* become infinite when done during eclipse even though it may be night which is otherwise called *āsurī* (*CVC*. III.2. p. 387, *KV*. p. 527, *VKK*. p. 108). It is said that *śrāddha* is to be performed by all means during eclipse. Otherwise one will sink down like a cow in mud (*SMP*. p. 762, *VKK*. p. 93).

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[19] *SMP*. p.716.
उपोष्य तद्दिनं सम्यक् परेऽह्नि श्राद्धमाचरेत् ॥

[20] रात्रौ श्राद्धं न कुर्वीत राक्षसी कीर्तिता हि सा ॥

The term *śrāddha* is to be taken here in the sense of *āma* (*śrāddha* performed with uncooked grains) or *hema* (*śrāddha* with money). The *Smṛtimuktāphala* (pp. 756, 821) says that when there is some unexpected calamity, non-availability of fire and brāhmaṇas or the occurrence of solar / lunar eclipse, *āmaśrāddha* is to be performed. Thus *śrāddha* at *grahaṇa* is brought under the *āma* category. Further, it is difficult to perform a *śrāddha* at the time of eclipse since most eclipses are partial and the time is short. Also there are restrictions for eating and cooking during eclipses. The person partaking food at eclipse is liable to undergo expiation. But the person performing *śrāddha* during an eclipse is deemed to reap great benefits.[21] The *Smṛtimuktāphala* (p. 737) says that a *tarpaṇa*, an offering with sesame (*tila*) and water is to be done before performing a *śrāddha* at an eclipse.

Dāna

The *Dharmaśāstra* texts assert that one should do *dāna* at *rāhudarśana* (*VKK*. p. 93). *Dharmasindhu* (p. 63) says that gift of cow, land, gold, grains etc. will yield merit. Also all *dāna* done at the time of eclipse become *bhūmisama* i.e. equal to gift of land. What is to be kept in mind is that one should give *dāna* to a learned and worthy recipient (*satpātra*); for, this alone will lead to accruing of merits. That *dāna* has been done since ancient times during eclipses is recorded in inscriptions.

Regarding the time at which *snāna, dāna*, etc. are to be done, the *Caturvargacintāmaṇi* (III.2. p.389) and *Kālaviveka*

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[21] *CVC*. III.2. p. 386, *KV*. p. 526, *NS*. I. p. 292.
तेनैव सकला पृथ्वी दत्ता विप्रस्य वै करे ॥
CVC. III.2. p.386, *KV* p. 531, *VKK*. p. 93.
राहुदर्शनदत्तं हि श्राद्धमाचन्द्रतारकम् ।

(p. 536) quoting Vṛddha-Vaśiṣṭha say that the gods and manes are pleased at *sparśa-samaya* (beginning), mortals at *madhyakāla* (middle) and demons at *mokṣakāla* (end). Hence no act (*kriyā*) is prescribed at *muktikāla* since it is a forbidden period.[22] But Śātātapa (q. by *KV*. p. 536) prescribes *muktikāla* for *dāna*.

Japa / Mantra

Japa is prescribed during eclipse perhaps as an act of self-discipline and control of mind and also to divert the mind from indulging in any forbidden act. It is stated that *mālinya* or impurity arises by not doing *japa* during eclipses (*CVC*. III.2. p. 389, *VKK*. p. 109). It is interesting to note that no particular *japa* is prescribed in these texts. Any *mantra* would bear fruit and one could pray to any *iṣṭadevatā*.

Eclipses are considered the best time for *mantropadeśa*, *dīkṣā* and *mantrasiddhi*. According to *Dharmasindhu* (p. 64) *māsa*, *nakṣatra* etc. need not be considered for *mantradīkṣā* at eclipses. *Varṣakriyākaumudī* (pp. 109-10) speaks of *puraścaraṇa* at the time of eclipse by standing in water and muttering holy syllables to attain *mantrasiddhi*.

The *Dharmaśāstra* texts are unanimous in stating that the period of solar eclipse is more meritorious than the lunar eclipse (*CVC*. III.2. p. 384, *KV*. p. 521, *VKK* p.113). According to *Parvanirṇaya* (p. 422), solar eclipse is more suitable for *mantragrahaṇa* than lunar eclipse.

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[22] त्रिदशाः स्पर्शसमये तृप्यन्ति पितरस्तथा ।
मनुष्या मध्यकाले तु मोक्षकाले तु राक्षसाः ॥

Acts prohibited during eclipse

Manu (IV. 37)[23] says that one should not look at the sun during a solar eclipse. It is said that direct viewing of the sun at eclipse with the naked eye or a telescope even for a brief moment would cause permanent damage to the eye and possibly also blindness.[24] Hence the use of heavily smoked glass or dark photographic film is advised. The *Brahmasiddhānta* (q. by *NS*. I. p.302)[25] speaking of the mode of viewing the sun at an eclipse says that one could see the image of the eclipsed sun reflected on a piece of cloth obtained through reflection from a mirror or vessel containing oil or water. The *Siddhāntaśekhara* (4.86)[26] says that one could view a *graha* (planet) or *grahaṇa* (eclipse) through the reflection obtained from a vessel filled with water.

Manu (IV. 110)[27] says that a brahmin should not recite Veda for three days at eclipses since he is impure during that period. *Kālaviveka* (p. 338)[28] says that one should not take bath with *āmalaka* (myrobalan) during eclipses. *Nirṇayasindhu-vyākhyā* (I. p. 283) says that if one falls asleep during eclipse he will be afflicted with sickness and if he urinates he would suffer from penury. Infections would be caused by voiding excrement at the time of eclipses and indulgence in sex would result in his being born as a pig. By taking oil bath he would become a leper and by partaking food he would face degradation and downfall. By indulging in talk during eclipses he would be born as a snake and by killing somebody he would reach eternal perdition.

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[23] नेक्षेतोद्यन्तमादित्य नास्तंयन्तं कदाचन ।
नोपसृष्ट न वारिस्थं न मध्यं नभसो गतम् ॥

[24] According to modern medical terminology, 'eclipse blindness' is called 'solar retinopathy' or 'photoretinitis'. "By exposure of the eyes to a solar eclipse it is said that practically all the visible rays and many infra-red rays pass unimpeded to the retina and burn it. Glasses impervious to infra-red rays should be used prophylactically" (*Parson's Diseases of the Eye*, p. 211).

[25] सर्वैः पटस्थितं वीक्ष्यं खस्थं तैलाम्बुदर्पणैः ।
ग्रहण गुर्विणी जातु न पश्यत पटं विना ॥

[26] व्यस्तकर्णभुजसंयुतिचिह्ने निर्मलाम्बुपरिपूरितपात्रे ।
दर्शयेद् ग्रहमथ ग्रहणं वा कौतुकार्थमवनीतलभर्तुः ॥

[27] त्र्यहं न कीर्तयेद् ब्रह्म राज्ञो राहोश्च सूतके ।

The period of eclipse was considered unfit to do certain auspicious things like marriage and *upanayana*.[29] A marriage could be performed a night after an eclipse and an *upanayana*, after three nights. One could proceed on a journey after seven nights (*PN.* p. 423). According to Garga (q. by *PN.* p. 424)[30] three days before and seven days after eclipse are considered *aśubha*. The *Nirṇayasindhu* (I. pp. 302-3) and *Vīramitrodaya* (*samayaprakāśa* p.127) quoting Hemādri say that starting from *trayodaśī*, nine days are to be avoided to do anything auspicious at solar

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28. चन्द्रसूर्योपरागे च स्नानमामलकैस्त्यजेत् ॥

29. For the Chinese, if an eclipse of the sun occurs when a sacrifice is progressing, then the sacrifice should be stopped. If the solar eclipse occurs in the course of a burial when the bier has been drawn to the path, then the bier should be stopped on the left of the road and allowed to wait till the eclipse is over. **To some tribes in America a journey is interrupted, work ceases and a ceremony is deferred during an eclipse of the sun. (*The texts of Confucianism*, III. pp. 329, 338-39; *Ency. of Rel. and Ethics* X. p. 369).**

30. चन्द्रसूर्योपरागे तु त्र्यहं प्रागशुभं भवेत् ।
सप्ताहमशुभं पश्चात् स्मृतं ग्रहणसूतकम् ॥

and lunar eclipses. It is also stated that the period starting from *dvādaśī* to *tṛtīyā* in the case of lunar eclipse and *ekādaśī* till *caturthī* in the case of solar eclipse, is called *vedha.*[31] In the case of partial eclipse three days are to be avoided. The *Parvanirṇaya* (p. 424) quoting Vasiṣṭha says that the number of days that are to be avoided in the case of total eclipse is eight. But if one third, half or one fourth of the disc is eclipsed, the number of days to be avoided are six, four and three respectively.

There is a popular view that pregnant women are not to be exposed to eclipse since this may result in a handicapped off-spring. A possible explanation of this could be made on the basis of the *piṇḍāṇḍa* theory that whatever is in the macrocosm exists in the microcosm also. Caraka (4.4 13) says that the cosmic elements that exist in the universe is present in the individual. It is said that the essentials for begetting a healthy child was dependent upon the physical and mental condition of the mother. Also, perhaps it was considered that the fear produced by the eclipse if transmitted to the baby in the womb would cause evil effects. *Bṛhatsaṁhitā* (5.24, 79, 85, 93) speaks of the destruction or trouble to the child in the womb only under certain specific circumstances like an eclipse occurring a little earlier than the calculated time, an eclipse followed by thunder, one taking place in the month of *bhādrapada* or the end of eclipse occurring in the northern side (*vāmakukṣibheda*) of the moon's disc. Speaking on the characteristics of halos Varāhamihira (*Bṛhatsaṁhitā* 34.15) says that the presence of Rāhu inside the *pariveṣa* or halo of the moon would bring trouble to the child in the womb.

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[31] द्वादश्यादितृतीयान्तो वेध इन्दुग्रहे स्मृत: ।
एकादश्यादिक: सौरे चतुर्थ्यन्त. प्रकीर्तित: ।।

Cūḍāmaṇigrahaṇa

When a solar eclipse occurs on a sunday (*sūryavāra*) and a lunar eclipse on a monday (*somavāra*) it is called *cūḍāmaṇigrahaṇa* (*KV*. p. 522).[32] The merit it bestows is a crore times more than the eclipse occurring on an ordinary day.

Gajacchāyā

When Saiṁhikeya (Rāhu) catches hold of the sun at *parvasandhi*, it is called *gajacchāyā*.[33] One is supposed to get infinite merit by performing a *śrāddha* at that time. Medbātithi (on Manu III. 274)[34] observes, that the view of Svarbhānu taking the form of an elephant and concealing the sun is not correct. But the view that *hasticchāyā* is different from eclipse is accepted by him. Yājñavalkya (I. 215)[35] also holds the same idea. On this, the commentator Viśvarūpa explains that *gajacchāyā* takes place when the moon is in *maghā* and the sun in *hasta* on the thirteenth day of the dark fortnight in the rainy season.[36]

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[32] सूर्यग्रहः सूर्यवारे यदा स्यात्पाण्डुनन्दन ।
चूडामणिः समाख्यातः सोमे सोमग्रहस्तथा ॥

[33] *SMP*. p. 760.
सैंहिकेयो यदा सूर्यं ग्रसते पर्वमन्धिषु ।
गजच्छाया तु सा प्रोक्ता तस्यां श्राद्धं प्रकल्पयेत् ॥

[34] ग्रहोपरागो हस्तिच्छायोच्यते । हस्ती वै भूत्वा स्वर्भानुरासुरिरादित्यं तमसाविध्यदिति । तदयुक्तम्, तत्र हि गौणो हस्तिशब्दप्रयोगः । स्मृत्यन्तरे च पृथगेव हस्तिच्छाया ग्रहोपरागादाम्नाता ।

[35] व्यतीपातो गजच्छाया ग्रहणं चन्द्रसूर्ययोः ।

[36] यदि स्याच्चन्द्रमाः पित्र्ये करे चैव दिवाकरः ।
वर्षासु च त्रयोदश्यां सा छाया कुञ्जरस्य तु ॥

Grahaṇaśānti

Śāntis are prescribed for persons in whose natal star the eclipse occurs and for those who are born during that period.[37]

'*Svarbhānoradha yadindra*' (*RV* 5.40.6) is used as *śānti mantra* for warding off the evil arising from the birth of a child during an eclipse (*Ṛgvedīya-Brahmakarmasamuccaya*, p. 231).

The *Sāṅkhāyana Śrauta Sūtra* (14.36.1 and 2) refers to the usage of hymns *yam vai sūryam svarbhānuḥ* and *svarbhānoradha yad* (*RV*. 5.40.9,6) in the context of one-day sacrifice, *āditya*, which a person wishing for lustre performs:

> 'यं वै सूर्यं स्वर्भानुः' 'स्वर्भानोरध यद्' इत्यादित्याभिव्याहारे निविद्धाने । तदेतस्याह्नो रूपम् ।।

The hymn *śakadhūmam nakṣatrāṇi* (*AV*. 6.128.1-4) is prescribed as *prāyaścitta* for an eclipse of the moon in the *Kauśika Sūtra* 100.3-4:

> शकधूमं नक्षत्राणीत्येतेन सूक्तेन जुहुयात् ।।
> सा तत्र प्रायश्चित्तिः ।।

Atri (q. by *KV*. p. 543, *VKK*. p. 115) says that the person in whose natal star there is *grāsa* of sun / moon, would be afflicted by *vyādhi* (sickness), *pravāsa* (exile), *mrtyu* (death) and *rājabhaya* (fear from king). Hence he should do *japa* and *devārcana* and give *dāna* for *śānti*.

The *grahaṇa* which occurs in the third, sixth, tenth or eleventh place from one's *janmarāśi* will produce good.

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[37] The penultimate chapter of Quran (113.1.3) contains a spell designed to ward off the evil influence that accompanies an eclipse (*Ency. of Rel. and Ethics*, X. p. 369).

If it takes place in the second, seventh, ninth or fifth it will have *madhyamaphala*. But if the *grāsa* takes place either in the *janmarāśi* or in the fourth, eighth or twelfth *rāśi*, then it will produce evil effects (*DS*. p. 69).

To ward off the evil effect, one should give a silver *candrabimba* and a golden *nāgabimba* as *dāna* in the case of *candragrahaṇa* and a golden *sūrya* and *nāgabimba* in the case of *sūryagrahaṇa*. The *bimba* should be placed in a brass or iron vessel filled with ghee and given as *dāna* along with *tila*, *vastra* and *dakṣiṇā* (*DS*. pp. 69-70). Even gold could be gifted to a brahmin, says *Varṣakriyākaumudī* (p. 117).

Matsya Purāṇa (67. 9) says that the one in whose *rāśi* the eclipse takes place, should take bath in water mixed with medicinal herbs like *uśīra*, *guggulu*, *gajadanta*, *kumuda*, *candana*, *pañcaratna*, pearls and *sphaṭika*. He should also recite the following verse.

> योऽसौ वज्रधरो देव आदित्यानां प्रभुर्मतः ।
> सहस्रनयनश्चन्द्रो ग्रहपीडां व्यपोहतु ।।

The same verse should be written in a golden *vastrapaṭṭa* or a leaf studded with *pañcaratnas* and should be worn on the forehead by the person. He should then pray to the deity of his desire *(iṣṭadevatā)*, give clothes and *godāna* to a brahmin and finally give away the band *(paṭṭa)* also as *dāna* to the brahmin.

As far as the terrestrial effects of eclipse are concerned, *Parvanirṇaya* (p. 416)[38] says that during eclipse, a peculiar kind of wind and lightning appear and these are harmful to living creatures, especially the human beings. The evil effects could be warded off by a holy dip, worship and oblation to the manes.

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[38] एव च रविचन्द्रयोर्वा भूभाचन्द्रयोर्वा समागमे एकस्तादृशो विचित्रो वायुः विद्युच्च निःसरति, तेन तया च जीवानां विशेषतस्तत्रापि मनुष्याणां महती हानिः संभवति ।

It is interesting to note that while explaining the *piṇḍāṇḍagrahaṇa-siddhānta,* Vallalār[39] describes *grahaṇa* as both external (*aṇḍa*) and internal (*piṇḍa*). In this connection he says - "the *aṇḍa* and *piṇḍa* are pervaded by two *vāyus, amṛta vāyu* and *viṣavāyu.* The latter is in two gaseous states. Of these one is black and the other red, and are called Rāhu and Ketu. The *viṣavāyu* pervades the sun and moon during the solar and lunar eclipses. These are the periods of impurity and darkness, since the light of sun or moon is obscured. This is *aṇḍagrahaṇadoṣa.* Analogous to this, is the *piṇḍagrahaṇadoṣa*, i.e., the obscurity of the consciousness; this occurs when a person is being immersed in the pleasures of the senses".

Thulasiram[40] in his study on Vallalar equates *viṣavāyu* to helium. He says - "Possibly during eclipses when the sun, moon and earth fall in one line involving a change in their total gravitation and magnetic fields, there might be a slightly excess percentage of helium nuclei (the heavy alpha particles) over hydrogen nuclei (the energetic particles) in the contents of charged cosmic particles that primarily reach the earth through its upper atmosphere."

There are good reasons to believe that eclipses have some impact on the beings of the earth. With the exception of a few instances like the action of the luminaries on the

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39. *Tiru-Arutpā*-Uraiṉataippagudi, pp. 249-51.

40. *Vallalar's vision of Nuclear Physics and Nervous system,* pp. 53-66.

tides, solar flares and sunspot activities, researchers in science are yet to trace the terrestrial effects due to celestial phenomena like eclipses.

From the Dharma Śāstra references we come to know of the following facts :

1. Great religious sanctity was attached to the period of eclipse. It was considered the best time for doing *japa*, *śrāddha*, *dāna* and for initiation and perfection of *mantras*.

2. It was a forbidden period for indulging in any worldly activities.

3. During the period of eclipse impurity pervadess Hence people are prohibited from taking food or drink. even three *yāmas* before a lunar eclipse and four *yāmas* before a solar eclipse. People are to take bath at the beginning and end of the eclipse and then follow their usual routine.

CONCLUSION

In the foregoing chapters some important references to eclipses in the Vedas, Epics, Purāṇas, Jyotiṣa texts, and Dharmaśāstras have been mentioned and analysed. The study has brought out a few crucial points about eclipses, their concepts and explanations in the varied texts, superstitions about them etc. The salient points of the study, in brief, are :

1. The belief of a demon (Rāhu) causing eclipses had its beginning in the Vedas (as is borne out by references to Svarbhānu in the *Ṛgveda*, *Taittirīya Saṁhitā* and Brāhmaṇas, and later to Rāhu in the *Atharvaveda*). This idea evolved into a myth having its basis in the *amṛtamathana*-episode in the *Mahābhārata* and was further elaborated in the Purāṇas like *Skanda*, *Matsya*, *Bhāgavata*, *Padma* and *Śiva*.

2. Regarding the astronomical and other factors about eclipses, it is found that there are vague references about the colour of the eclipsed disc in the Vedic texts and the *Mahābhārata*. During the Epic and Purāṇic times, the Hindus were able to associate eclipses with new/full moon days. The idea that the phenomenon is one of concealment or obscuration of the light of a luminous body had gained ground during the Purāṇic times. There are also occasional references, during the same period, to the shadow of earth and moon with regard to eclipses. Rāhu was believed to take the form of the shadow of earth and moon, to cause eclipses.

3. The references to Atri in the *Ṛgveda*, Brāhmaṇas, *Mahābhārata* and Purāṇas as the one who dispelled the darkness at eclipse, probably identifies him as a person who had insight into the cause and duration of eclipse.

4. From the fifth century onwards astronomers like Āryabhaṭa, Varāhamihira, Lalla and Bhāskara have given the astronomical basis for eclipses viz., that the solar and lunar eclipses are caused by the moon and the shadow of earth respectively. They have also given mathematical calculations regarding the time, duration conditions and direction of their occurrence. They have made it clear that eclipses are not caused by the mythological demon Rāhu.

5. The astronomical texts also contain descriptions on the change of colour on the eclipsed disc. Varāhamihira makes a classification of eclipses into ten kinds on the basis of the eclipsed/liberated portion of the sun/moon.

6. The terms Rāhu and Ketu are retained but are widely used in the astronomical texts to refer to the ascending and descending nodes (*Pātas*). The term *tamas* is also used in the technical sense of earth's shadow cone at moon's distance.

7. Astronomers like Brahmagupta, Bhāskara and Śrīpati, besides giving the scientific computation of eclipses, have later tried to bring about a reconciliation by stating that Rāhu through the medium of moon and shadow of earth causes solar and lunar eclipses respectively. Varāhamihira tries to equate Rāhu to the node but considers Ketu as a comet. Thus the myth of demon Rāhu has come to be merely an allegorical representation of the astronomical phenomena.

8. The Dharmaśāstras have mentioned the evil effects of eclipses on human beings. They have also prescribed various rituals and expiatory acts to counteract the evil. These are to some extent practised even today. The negative effects of the shadows of astronomical bodies on living beings and the efficacy of rituals still remain matters of enquiry.

APPENDIX

EFFECTS OF ECLIPSES

(A = Atharvapariśiṣṭa 53.2.3-6.6;
B = Bṛhatsaṁhitā 5.24-98)

1. **Actual occurrence**	**Effects**
a. taking place a little earlier than the calculated time	miscarriages and outbreak of war (B)
b. taking place a little later	flowers would wither; destruction of fruits and crops; panic among people (B)
2. **Time of occurrence**	
a. being eclipsed when sun or moon rises or sets	failure of autumnal crops (A,B); danger to kings (B); people would subsist by summer roots and fruits (A)
b. if such an eclipse be total and for long duration; if the eclipsed disc be "aspected by malefics."	famine and pestilence would prevail (B); destruction of prosperous kingdom and the king (A)
c. commencing when sun or moon has just half-risen	the lower tribes will suffer; disruption of sacrifices (B)
d.i. visible portion of the sky being divided into seven equal divisions and if the eclipse happens in the I division	trouble for those earning their livelihood with the help of fire; also for virtuous men, hermits and brahmins (B)
ii. eclipse happening in the II division	grief for agriculturists, heretics, traders, Kṣatriyas and army-chiefs (B)

iii.	in the III division	harms artisans, artists, low castes, ministers and Śūdras (B)
iv.	at mid-day i.e. the central or IV division of the sky	suffering for the king and the central country; fair prices for grains (B)
v.	in the V division	suffering for quadrupeds, ministers, people in the harem, and Vaiśyas (B)
vi.	in the VI division	destruction of women and Śūdras (B)
vii.	if at the settting time	annihilation of thieves and dwellers of the border countries (B)
viii.	end of eclipse happening in whichever division of the sky	benefits the people of relevant division (as given above) (B)
e.i.	occurring in the *uttarāyaṇa*	destruction of brahmins and kings (B)
ii.	occurring in the *dakṣiṇāyana*	destruction of Vaiśyas and Śūdras (B)

3. At different quarters

a.	sighted at the four quarters beginning with north	suffering for people of the four castes (B)
b.	in any one of the four cardinal points	trouble to Mlecchas, marching armies and those who live by fire (B)
c.i.	beginning in the south	destruction to acquatic animals and elephants (B)
ii.	in the north	cattle would perish (B)

iii. in the east	the earth would be inundated by floods (B)
iv. in the west	destruction of agriculturists, dependents, labourers, seeds and seedlings (B)

4. At the twelve rāśis

a. when sun or moon is eclipsed while occupying the sign *Meṣa*	grief to Pāñcālas, Kaliṅgas, Śūrasenas, Kāmbojas, Uḍras, hunters, warriors, and those who work by fire (B)
b. in *Vṛṣabha*	suffering to shepherds, cattle and their owners, and persons of eminence (B)
c. in *Mithuna*	affliction to ladies of nobility, kings, powerful ministers, artists, people living on the banks of Jumnā, people of Balk, the Matsyas, and the Suhmas (B)
d. in *Karkaṭaka*	suffering to Ābhīras, Śabaras, Pallavas, Matsyas, Kurus, Śakas, Pāñcālas and infirm persons; destruction of food grains (B)
e. in *Siṁha*	destruction of hunters, Mekalas, the valorous chieftains, kings and forest-dwellers (B)
f. in *Kanyā*	affliction to crops, regions with paddy fields, poets,

	writers, musicians and people of Aśmaka and Tripura (B)
g. in *Tulā*	suffering to people of Avanti, Aparāntya (western border), Daśārṇa, Marus, Kacchapas, the virtuous and traders (B)
h. in *Vṛścika*	destruction of Udumbaras, Madras, Colas, Yaudheya tribe, soldiers and trees (B)
i. in *Dhanus*	destruction of Videhas, Pāñcālas, chief ministers, wrestlers, physicians, traders, warriors and horses (B)
j in *Makara*	destruction of fishes ministers and their families, men of lower class, those who are clever in the use of magic and herbs, soldiers and old and infirm persons (B)
k. *in Kumbha*	harm to bearers of burdens, thieves, mountain-dwellers, men living in the west, the Ābhīras, the Daradas, nobles, people of Siṁhapura and Barbaras (B)
l. in *Mīna*	destruction of substances obtained on the shores and derived from the seas,

		people in forests, learned men and men living on water and water-products (B)

5. Types of eclipses

a.	*Savya* - if lunar eclipse commences from south-east or solar from north-west	floods inundate the world; happiness and freedom from fear will prevail (B)
b.	*Apasavya* - if lunar from north-east or solar from south-west	oppression of people by the sovereign (A, B); and robbers (B)
c.	*Leha/Parilehana* - if the orb of sun/moon is enveloped by darkness	happiness to all beings; abundance of water all over the earth (B)
d.	*Grasana* - when a third or a fourth part of the disc or even half is concealed by darkness	loss of wealth to flourishing kings and countries (B)
e.	*Nirodha* - when the disc is eclipsed all round leaving a lump of thick darkness in the middle	happiness to all creatures (B)
f.	*Avamardana* - when the eclipse is total i.e. when the entire orb is concealed and is in that position for a considerably long period	destruction of prominent kings and leading countries (B)
g.	*Ārohaṇa* - if soon after the termination of the	mutual strife among kings causing great panic (B)

	eclipse, the luminary be again enveloped by darkness	
h.	*Āghrāta* - when it appears on a part of the disc like a mirror filled with the vapour of hot breath when blown on it	timely rains and prosperity to the world (B)
i.	*Madhyatama* - when Rāhu appears in the centre of the disc and the entire (circular) portion surrounding the same is unconcealed (occurs only in a solar eclipse)	affliction to people living in the central countries; suffering from colic (B)
j.	*Tamo'ntya* / *Upaplava* - when the entire surrounding portion in the disc appears thickly dark while in the middle or central portion it is only slight	danger to the crops through locusts etc; fear from thieves (B)

6. Colours of the eclipsed disc

a.	white	peace and prosperity all over ; (B) brahmins will suffer (A,B)
b.	colour like fire	risk from fire; people who earn their livelihood through fire will suffer (A,B)
c.	green	outbreak of diseases; crops destroyed by excessive rains (B)

d.	reddish or tawny	destruction to Mlecchas and swift-moving animals like camels; famine (B)
e.	resembling the rays of the rising sun	famine and drought; trouble to birds (B)
f.	grey	well-being and prosperity; but limited rain (B)
g.	reddish in colour or of the colour of the pigeon or of gold or yellow or black	people will suffer from famine (B)
h.	colour of the pigeon or dark	Śūdras will suffer diseases (A,B); there will be winds (A)
i.	colour of a spotless jewel (topaz) or yellowish	suffering to Vaiśyas (A,B); destruction to the crops (A); but prosperity in the land (B)
j.	colour like that of burning flame	risk from fire (B)
k.	colour of a mineral	outbreak of wars (B)
l.	dark like the Dūrvā stalks or yellowish	outbreak of epidemics (A,B)
m.	red like Pāṭala flower	risk from lightning and thunderbolt (B)
n.	mixture of red and brown or red and black	loss of rain (B); ruin of Kṣatriyas (A,B); threat from weapons (A); the minister will kill the king and *vice versa* (B)

o.	similar to the rising sun, the lotus or the rainbow	outbreak of war (B)

7. Aspects of planets on the eclipsed sun/moon

a.	— Mercury on the eclipsed sun/moon	scarcity of ghee, honey and oil; kings will suffer (B)
b.	— Mars	outbreak of war; risk from fire; danger from thieves (B)
c.	— Venus	destruction of crops; all kinds of miseries and troubles (B)
d.	— Saturn	drought, famine and risk from thieves (B)
e.	— Jupiter	mitigates the evil effects of the aspects of planets; proves beneficial (B)

8. Planets in conjunction with eclipsed sun/moon

a.	Mars in conjunction with the eclipsed sun/moon	suffering for autocratic kings, people of Avanti and those living on the banks of Kāverī and Narmadā (B)
b.	— Mercury	destruction of people living in the area between Gaṅgā and Yamunā, those on the banks of Sarayū, Śoṇā and on the east coast, Nepal; kings, warriors, women, boys, and learned men (B)
c.	— Jupiter	destruction of learned men, kings, ministers, norther-

	ners, dwellers on the banks of Indus, elephants and horses (B)
d. — Venus	suffering for Dāśerakas, Kekayas, Yaudheyas, Āryāvartas, Śibis, women, ministers and tribes (B)
e. — Saturn	loss for men of Maru (desert), Puṣkara, Saurāṣṭra, minerals, dwellers of Arbuda and Pāriyātrā mountains, lowcastes and cowherds. (B)

9. At the twelve months

a. — Kārtika	affliction to the entire Kṣatriya clan, to those who live by fire, to those in Benares, kings in the east, to Magadhas, Kośalas, Śūrasenas, Kalmāṣas and the Kaliṅga king along with his ministers and servants; happiness and prosperity to all others (B)
b. — Mārgaśiras	suffering for Kashmiris, Kośalas, Puṇḍras, Westerners, forest-dwellers, and Somayājis; good rains; happiness and prosperity to all (B)
c. — Puṣya	trouble to brahmins, Kṣatriyas, Saindhavas, Kukuras

	and Videhas; scanty rainfall, famine and panic (B)
d. — Māgha	trouble to people devoted to parents, brahmins of Vasiṣṭha gotra, religious and pious, people of Bengal, Aṅga and Kāśi, elephants, horses; plenty of rains (B)
e. — Phālguna	trouble to Bengalis, Aśmakas, dwellers of Avanti and Mekala mountain, Kṣatriyas, hermits, agriculturists, noble women, dancers and bow-makers. (B)
f. — Caitra	trouble to writers, artists, Vaidikas, gold smiths, jewellers, Puṇḍras, Uḍras, Kekayas and Aśmakas; erratic rainfall (B)
g. — Vaiśākha	destruction of cotton crop, sesamum, green gram; suffering for Ikṣvākus, Yaudheyas, Śakas, Kaliṅgas; plenty of crops otherwise (B)
h. — Jyeṣṭha	destruction of kings, queens, brahmins, gentle folk, Sālvas, hunters; less rains and poor crops (B)
i. — Āṣāḍha	destruction of wells, tanks; dried rivers; scattered rains; suffering to Gāndhāras, Kashmiris, Pulindas, Chinese and hermits (B)

j. — Śrāvaṇa	trouble to Kashmiris, Pulindas, Gāndhāras, Kāmbojas, Yavanas in Kurukṣetra and Central India, Chinese and single-hoofed animals; damage to autumnal crops; happiness to all others (B)
k. — Bhādrapada	affliction to Kaliṅgas, Bengalis, Magadhas, Daradas, Surāṣṭras, Mlecchas, Suvīras, Aśmakas; women will suffer miscarriages; but prosperity will prevail (B)
l. — Āśvayuja	sufferings to Kāmbojas, Ānartas, Kirātas, Vālhikas, Puṇḍras, Yavanas, Chinese, surgeons, physicians, dwellers on the bank of Indus; but abundance of food and provisions. (B)

10. Effects of varieties of liberation of eclipse

a. liberation of moon in the south-east quarter of the orb (*dakṣiṇahanu*)	destruction of crops; trouble to sovereigns; spreading of facial diseases; but good rains (B)
b. north-east quarter (*vāmahanu*)	trouble and danger to princes; facial diseases; risk by weapons; plenty of food and rains (B)
c. southern side (*dakṣiṇakukṣi*)	trouble to princes; conflict with enemies of south (B)

d.	northern side (*vāmakukṣibheda*)	miscarriages; moderate crops (B)
e.	south-western side (*dakṣiṇapāyu*)	suffering from diseases of generating organs; poor rains (B)
f.	north-western side (*vāmapāyu*)	suffering from diseases of generating organs; poor rains; death to queen (B)
g.	commencement and end be on the eastern side (*sañchardana*)	prosperity and peace; abundance of crops; general contentment (B)
h.	commencement in the east, liberation at the west (*jaraṇa*)	suffering from hunger; threat of weapons; utter helplessness (B)
i.	liberation beginning from the middle (*madhyavidaraṇa*)	trouble in the king's army; not much rain; but peace and prosperity to all (B)
j.	liberation beginning at the rim with intense darkness in the middle (*antyavidaraṇa*)	ruin for the central country; ruin to autumnal crops (B)

11. Natural calamities within a week after an eclipse

a.	dust storm	famine (B)
b.	heavy dew	spreads diseases (B)
c.	earthquake	an important king dies (B)
d.	fall of meteor	a minister is destroyed (B)
e.	clouds of various colours	extreme panic (B)
f.	thunder	miscarriages (B)
g.	flash of lightning	kings, serpents etc. give trouble (B)
h.	*pariveṣa* (halo)	diseases (B)

i.	abnormal redness of horizon	danger from kings; risk from fire (B)
j.	fierce and stormy winds	fear from thieves (B)
k.	portentuous thunder, rainbow or daṇḍa (a rod-like cloud collection)	suffering from famine; attack from enemy's army (B)
l.	clash of planets	outbreak of war between kings (B)
m.	*Ketu* (comet) visible	war among kings (B)
n.	clear shower of rains	prosperity and peace; untoward effects of eclipse are warded off (B)

12. Miscellaneous

a.	both solar and lunar eclipses occurring in one and the same month	revolt in the army; destruction of kings (B); terrible blood-shed (A, B); no rains in spring (A)
b.	solar following a lunar at the end of the fortnight	people become wicked and unjust; disharmony among couples (B)
c.	lunar following a solar in the next fortnight	brahmins performing sacrifices are blessed; entire population is happy and content (B) (*Atharvapariśiṣṭha* forecasts calamity).
d.	at solar / lunar eclipse, strong wind, fall of meteors, dust storm, earth-quake, total darkness or thunderbolt occur.	the eclipse will return after 6, 12, 18, 24, 30 and 36 months respectively.

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